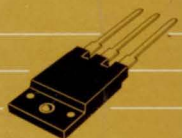
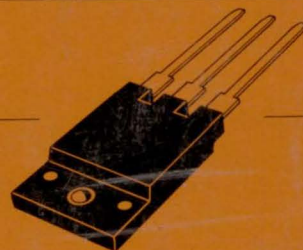


'85 SEMICONDUCTOR HANDBOOK

TRANSISTORS

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**QUICK
SELECTION
GUIDE**

FUNCTIONAL INDEX

GENERAL INFORMATION

**2SA-TYPE
(HF PNP)**

**2SB-TYPE
(LF PNP)**

**2SC-TYPE
(HF NPN)**

**2SD-TYPE
(LF NPN)**

**2SK-TYPE
3SK-TYPE
(FET'S)**

DEVELOPMENT NEWS

DATA SECTION

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1. FUNCTIONAL INDEX TO SEMI- CONDUCTOR PRODUCTS

This CHAPTER gives a summary of all transistor products available from Tokyo Sanyo Semiconductor Division as standard products.

TRANSISTOR PRODUCT SELECTION GUIDE BY USE

Note ※ : Under development

GENERAL APPLICATIONS (Classified by package and arranged in order of increasing P_C. Minus sign for PNP is omitted due to space limitations.)

● : Mounted on ceramic board (250mm²×0.8mm)

Type Number	Page	Case		Applications	Absolute Maximum Ratings/Ta=25°C						Electrical Characteristics/Ta=25°C									
		VCE0	VCE0		VEB0	IC	PC *TC=25°C	TJ	ICB0	hFE			fT							
										VCB	(max)	VCE	IC	VCE	IC	fT				
		Package	Package No.		[V]	[V]	[V]	[A]	[W]	[°C]	[V]	[A]	[V]	[A]	[V]	[A]	[MHz]			
*2SC3661	—	CP	2018	High hFE, AF Amp.	30	25	15	30m	200m	—	—	—	5	10m	800~3200	—	—	—		
2SA1179	91	CP	2018	AF Amp.	55	50	5	150m	200m	125	35	0.1μ	6	1m	90~600	6	10m	180		
2SC2812	295	CP	2018	AF Amp.	55	50	5	150m	200m	125	35	0.1μ	6	1m	90~600	6	1m	100		
2SA1252	111	CP	2018	AF Amp.	60	50	15	150m	200m	125	40	0.1μ	6	1m	100~560	6	1m	100		
2SC3134	405	CP	2018	AF Amp.	60	50	15	150m	200m	125	40	0.1μ	6	1m	100~560	6	1m	100		
*2SA1434	—	CP	2018	High hFE, AF Amp.	60	50	15	10m	200m	—	—	—	5	10m	500~1200	10	10m	100		
*2SC3689	—	CP	2018	High hFE, AF Amp.	60	50	15	100m	200m	—	—	—	5	10m	800~3200	10	10m	100		
					VGD0, VGD5*			IG	PD		VGS	IGSS	VDS	IDSS						
2SK283	965	CP	2021	AF Amp.	80*	—	—	10m	150m	125	30V	1.0n	30	—	1.2~17mA	—	—	—		
2SK303	968	CP	2021	AF Amp.	30*	—	—	10m	150m	125	20	1.0n	10	—	0.6~12mA	—	—	—		
2SK334	982	CP	2025	Capacitor Microphone	20	—	—	10m	100m	125	—	—	10	—	0.06~1.5mA	—	—	—		
					VDS			ID			VGS	IGSS	VDS	IDSS	VDS	IDSS	fYFSI			
*2SK536	—	CP	2025	Analog Switching	50	—	—	400m	200m	125	10	10n	20	—	<1.0μA	5V	—	35mS		
								IG			IGSS	VDS								
2SK545	1020	CP	2021	Impedance Converter	40	—	—	10m	100m	125	20	500pA	10	—	30~300μA	—	—	—		
*2SA1416	—	PCP	2038	AF Amp.	100	100	5	1.0	1.3●	150	80	1.0μ	5	100m	100~400	10	100m	120		
*2SC3646	—	PCP	2038	AF Amp.	100	100	5	1.0	1.3●	150	80	1.0μ	5	100m	100~400	10	100m	120		
2SC3651	673	PCP	2038	High hFE, AF Amp.	120	100	15	200m	1.3●	—	—	—	5	10m	500~2000	10	10m	150		
2SC3650	670	PCP	2038	High hFE, AF Amp.	30	25	15	150m	1.5●	—	—	—	5	500m	800~3200	10	50m	220		
*2SA1417	—	PCP	2038	AF Amp.	100	100	5	1.0	1.5●	150	80	1.0μ	5	100m	100~400	10	100m	120		
*2SC3647	—	PCP	2038	AF Amp.	100	100	5	1.0	1.5●	150	80	1.0μ	5	100m	100~400	10	100m	120		
2SA608	79	SP	2000B	AF Amp.	40	30	5	100m	200m	125	25	1.0μ	6	1m	60~560	6	10m	180		
2SC536	243	SP	2000B	AF Amp.	40	30	5	100m	200m	125	35	1.0μ	6	1m	60~960	6	1m	100		
2SA1253	112	SP	2000B	AF Amp.	60	50	15	200m	250m	150	40	0.1μ	6	1m	100~600	6	1m	100		
2SC3135	408	SP	2000B	AF Amp.	60	50	15	200	250m	150	40	0.1μ	6	1m	100~600	6	1m	100		
2SA1317	123	SPA	2033	AF Amp.	60	50	6	200m	300m	150	40	0.1μ	6	1m	100~800	6	10m	200		
2SC3330	475	SPA	2033	AF Amp.	60	50	6	200m	300m	150	40	0.1μ	6	1m	100~800	6	10m	200		
					VGD0, VGD5*			IG	PD		VGS	IGSS	VDS	IDSS	VDS	IDSS	crss			
2SK156	949	SP	2037	Capacitor Microphone	20	—	—	10m	100m	125	—	—	10	—	0.06~1.5mA	—	—	—		
2SK376	985	SP	2037	Capacitor Microphone	20	—	—	10m	100m	125	—	—	5	—	60~800μA	—	—	—		
2SK304	970	SP	2001B	AF Amp.	30*	—	—	10m	150m	125	20	1.0n	10	—	0.6~12mA	—	—	—		
2SK404	991	SPA	2034	AF Amp, HF Amp.	20	—	—	10m	200m	125	10	10m	5	—	1.2~12mA	5	—	1.3pF		
								IG												
2SK546	1023	SPA	2034	Impedance Converter	40	—	—	10m	100m	125	—	—	—	—	30~300μA	10	—	0.7pF		

Continued on nex page.

GENERAL APPLICATIONS Continued from preceding page.

Type Number	Page	Case		Applications	Absolute Maximum Ratings/Ta=25°C						Electrical Characteristics/Ta=25°C									
		VCB0	VCE0		VEB0	IC	PC *TC=25°C	TJ	ICB0			hFE			fT					
									VCB [V]	(max) [A]	VCE [V]	IC [A]		VCE [V]	IC [A]	[MHz]				
2SC3576	611	SPA	2033	High hFE, AF Amp.	30	25	15	300m	300m	150	20	0.1μ	5	10m	800~3200	10	10m	250		
2SK377	988	DP3	2026	Capacitor Microphone	20	-	-	10m	100m	125	-	-	5	-	60~800μA	-	-	-		
2SA1237	97	DP6A, B	2029A 2030A	Diff. Amp.	55	50	5	150m	200m	150	35	0.1μ	6	1m	100~560	6	1m	100		
2SC3064	354	DP6A, B	2029A 2030A	Diff. Amp.	55	50	5	150m	200m	150	35	0.1μ	6	1m	100~960	6	1m	100		
2SA1239	103	DP6A, B	2029A 2030A	Diff. Amp.	130	120	5	50m	200m	150	80	0.1μ	6	1m	160~560	6	1m	110		
2SC3066	360	DP6A, B	2029A 2030A	Diff. Amp.	130	120	5	50m	200m	150	80	0.1μ	6	1m	160~960	6	1m	130		
2SA608	79	NP	2003A	AF Amp.	40	30	5	100m	400m	125	25	1.0μ	6	1m	60~560	6	10m	180		
2SC536	243	NP	2003A	AF Amp.	40	30	5	100m	400m	125	35	1.0μ	6	1m	60~960	6	1m	100		
2SA608K	79	NP	2003A	AF Amp.	55	50	5	100m	400m	125	25	1.0μ	6	1m	60~560	6	10m	180		
2SC536K	243	NP	2003A	AF Amp.	55	50	5	100m	400m	125	35	1.0μ	6	1m	60~960	6	1m	100		
2SA1246	108	NP	2003A	AF Amp.	60	50	15	150m	400m	150	40	0.1μ	6	1m	100~560	6	1m	100		
2SC3114	398	NP	2003A	AF Amp.	60	50	15	150m	400m	150	40	0.1μ	6	1m	100~560	6	1m	100		
2SC3382	486	NP	2003A	AF Amp.	60	50	6	200m	400m	150	40	0.1μ	6	1m	100~560	6	10m	250		
2SC3383	489	NP	2003A	AF Amp.	60	50	6	200m	500m	150	40	0.1μ	6	1m	100~560	6	10m	250		
2SA1318	124	NP	2003A	AF Amp.	60	50	6	200m	500m	150	40	0.1μ	6	1m	100~800	6	10m	200		
2SC3331	478	NP	2003A	AF Amp.	60	50	6	200m	500m	150	40	0.1μ	6	1m	100~800	6	10m	200		
*2SA1392	—	NP	2003A	AF Amp.	60	50	6	200m	500m	150	40	0.1μ	6	1m	100~560	6	10m	200		
2SC3383	489	NP	2003A	AF Amp.	60	50	6	200m	500m	150	40	0.1μ	6	1m	100~560	6	10m	200		
*2SA1437	—	NP	2003A	High hFE, AF Power Amp.	120	100	15	50m	500m	-	-	-	5	10m	400~1000	10	10m	85		
2SC3495	595	NP	2003A	High hFE, AF Power Amp.	120	100	15	50m	500m	150	80	0.1μ	5	10m	500~2000	10	10m	170		
*2SA1435	—	NP	2003A	High hFE, AF Amp.	30	25	15	300m	600m	-	-	-	5	10m	500~1200	10	10m	100		
2SC3068	365	NP	2003A	High hFE, AF Amp.	30	25	15	300m	600m	150	20	0.1μ	5	10m	800~3200	10	10m	250		
*2SA1436	—	NP	2003A	High hFE, AF Amp.	60	50	15	200m	600m	-	-	-	5	10m	500~1200	10	10m	100		
2SC3069	368	NP	2003A	High hFE, AF Amp.	60	50	15	200m	600m	150	40	0.1μ	5	10m	800~3200	10	10m	250		
2SA984	84	NP	2003A	AF Power Amp.	60	50	5	500m	600m	150	40	1.0μ	5	50m	60~320	10	10m	120		
2SC2274	281	NP	2003A	AF Power Amp.	60	50	5	500m	600m	150	40	1.0μ	5	50m	60~320	10	10m	120		
2SA984K	84	NP	2003A	AF Power Amp.	100	80	5	500m	600m	150	40	1.0μ	5	50m	60~320	10	10m	120		
2SC2274K	281	NP	2003A	AF Power Amp.	100	80	5	500m	600m	150	40	1.0μ	5	50m	60~320	10	10m	120		
					VDS	VGS	-	ID	PD		VGS	IGSS	VDS	-	IDSS	VDS		Iy fsl		
2SK583	1026	NP	2005A	Analog Switch	50	±12	-	200m	600m	125	0	10n	20	-	<1.0μA	10		40ms		
2SB560	182	MP	2006A	AF Power Amp.	100	80	5	0.7	900m	150	20	1.0μ	5	50m	60~560	10	50m	100		
2SD438	712	MP	2006A	AF Power Amp.	100	80	5	0.7	900m	150	20	1.0μ	5	50m	60~560	10	50m	100		
*2SA1438	—	MP	2006A	High hFE, AF Amp.	30	25	15	1.2	1	-	-	-	5	500m	500~1200	10	50m	100		
2SC3070	371	MP	2006A	High hFE, AF Amp.	30	25	15	1.2	1	150	20	0.1μ	5	500m	800~3200	10	50m	220		
2SC3071	374	MP	2006A	High hFE, AF Amp.	120	100	15	200m	1	150	80	0.1μ	5	10m	500~2000	10	10m	150		
2SB631	184	TO126	2009	AF Power Amp.	100	100	5	1.0	8*	150	50	1.0μ	5	50m	60~320	10	50m	110		
2SD600	723	TO126	2009	AF Power Amp.	100	100	5	1.0	8*	150	50	1.0μ	5	50m	60~320	10	50m	130		
2SB631K	184	TO126	2009	AF Power Amp.	120	120	5	1.0	8*	150	50	1.0μ	5	50m	60~320	10	50m	110		
2SD600K	723	TO126	2009	AF Power Amp.	120	120	5	1.0	8*	150	50	1.0μ	5	50m	60~320	10	50m	130		
2SB632	185	TO126	2009	AF Power Amp.	25	25	5	2.0	10*	150	20	1.0μ	2	500m	60~320	10	50m	100		
2SD612	726	TO126	2009	AF Power Amp.	25	25	5	2.0	10*	150	20	1.0μ	2	500m	60~320	10	50m	100		

2SB632K	185	TO126	2009	AF Power Amp.	35	35	5	2.0	10*	150	20	1.0μ	2	500m	60~320	10	50m	100
2SD612K	726	TO126	2009	AF Power Amp.	35	35	5	2.0	10*	150	20	1.0μ	2	500m	60~320	10	50m	100
2SB511	178	TO220	2010A	AF Power Amp.	35	35	5	1.5	10*	150	20	0.1m	2	1	40~320	5	0.5	8
2SD325	699	TO220	2010A	AF Power Amp.	35	35	5	1.5	10*	150	20	0.1m	2	1	40~320	5	0.5	8
2SB514	179	TO220	2010A	AF Power Amp.	50	50	5	2.0	20*	150	20	0.1m	2	1	40~320	5	0.5	8
2SD330	702	TO220	2010A	AF Power Amp.	50	50	5	2.0	20*	150	20	0.1m	2	1	40~320	5	0.5	8
2SB515	179	TO220	2012	AF Power Amp.	50	50	5	2.0	20*	150	20	0.1m	2	1	40~320	5	0.5	8
2SD331	702	TO220	2012	AF Power Amp.	50	50	5	2.0	20*	150	20	0.1m	2	1	40~320	5	0.5	8
2SA1011	85	TO220	2010A	AF 100W Amp. Predriver	180	160	6	1.5	25*	150	120	10μ	5	300m	60~320	10	50m	100
2SC2344	286	TO220	2010A	AF 100W Amp. Predriver	180	160	6	1.5	25*	150	120	10μ	5	300m	60~320	10	50m	100
2SB507	177	TO220	2010A	AF Power Amp.	60	60	5	3.0	30*	150	20	0.1m	2	1	40~320	5	0.5	8
2SD313	693	TO220	2010A	AF Power Amp.	60	60	5	3.0	30*	150	20	0.1m	2	1	40~320	5	0.5	8
2SB508	177	TO220	2012	AF Power Amp.	60	60	5	3.0	30*	150	20	0.1m	2	1	40~320	5	0.5	8
2SD314	693	TO220	2012	AF Power Amp.	60	60	5	3.0	30*	150	20	0.1m	2	1	40~320	5	0.5	8
2SB633	186	TO220	2010A	AF Power Amp. (25to35W)	100	85	6	6.0	40*	150	40	0.1m	5	1	40~320	5	1.0	15
2SD613	733	TO220	2010A	AF Power Amp. (25to35W)	100	85	6	6.0	40*	150	40	0.1m	5	1	40~320	5	1.0	15
2SB775	190	TO3PB	2022	AF Power Amp. (35W)	100	85	6	6.0	60*	150	40	0.1m	5	1	60~200	5	1.0	18
2SD895	753	TO3PB	2022	AF Power Amp. (35W)	100	85	6	6.0	60*	150	40	0.1m	5	1	60~200	5	1.0	15
2SB776	192	TO3PB	2022	AF Power Amp. (40W)	120	100	6	7.0	70*	150	80	0.1m	5	1	60~200	5	1.0	15
2SD896	756	TO3PB	2022	AF Power Amp. (40W)	120	100	6	7.0	70*	150	80	0.1m	5	1	60~200	5	1.0	15
2SB816	195	TO3PB	2022	AF Power Amp.	150	120	6	8.0	80*	150	80	0.1m	5	1	60~200	5	1.0	15
2SD1046	764	TO3PB	2022	AF Power Amp.	150	120	6	8.0	80*	150	80	0.1m	5	1	60~200	5	1.0	15
2SB817	196	TO3PB	2022	AF Power Amp.	160	140	6	12	100*	150	80	0.1m	5	1	60~200	5	1.0	15
2SD1047	767	TO3PB	2022	AF Power Amp.	160	140	6	12	100*	150	80	0.1m	5	1	60~200	5	1.0	15

HIGH FREQUENCY APPLICATIONS

(Classified by package and arranged in order of decreasing f_T . Minus sign for PNP is omitted due to space limitations.)

Type Number	Page	Case		Applications	Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$							Electrical Characteristics/ $T_a=25^{\circ}\text{C}$							
		VCB0	VCE0 *VCER		VEB0	IC	PC	Tj	ICB0		hFE			fT					
									VCB	(max)	VCE	IC		VCE	IC				
		Package	Package No.		[V]	[V]	[V]	[A]	[W]	[$^{\circ}\text{C}$]	[V]	[A]	[V]	[A]		[V]	[A]	[MHz]	
2SC3142	411	CP	2018	HF Amp.	25	20	3	30m	150m	125	10	0.1μ	6	1m	40~180	6	4m	750	
2SC2813	297	CP	2018	HF Amp.	25	20	3	30m	150m	125	10	0.1μ	6	1m	40~270	6	4m	600	
2SC2814	300	CP	2018	HF Amp.	30	20	5	30m	150m	125	10	0.1μ	6	1m	40~270	6	1m	320	
2SA1256	113	CP	2018	HF Amp.	30	20	5	30m	150m	125	10	0.1μ	6	1m	60~270	6	1m	230	
					VGB0, VGBS*			IG	PD		VGS	IGSS	VDS		IDSS	VDS		crss	
2SK242	961	CP	2024	HF Amp.	20	-	-	10m	150m	125	0.5	10n	5	-	0.6~12mA	5	-	0.04pF	
2SK436	1000	CP	2021	HF Amp, AF Amp	15*	-	-	10m	150m	125	10	1.0n	5	-	1.2~12mA	5	-	2.0pF	
2SK443	1006	CP	2021	Video Camera 1st Stage	15*	-	-	10m	200m	125	10	1.0n	5	-	5~38mA	5	-	2.8pF	
					VDS			ID	PD		VGS	IGSS	VDS		IDSS			lyfs1	
2SK543	1018	CP	2024	MOS FET for FM RF	20	-	-	20m	200m	125	±5V	10n	10V	-	1.2~12mA	10	-	11ms	
2SC2999	333	SP	2000B	HF Amp.	25	20	3	30m	150m	125	10	0.1μ	6	1m	40~200	6	4m	750	
2SC2840	308	SP	2000B	HF Amp.	25	20	3	30m	150m	125	10	0.1μ	6	1m	40~200	6	4m	600	
2SC2839	304	SP	2000B	HF Amp.	30	20	5	30m	150m	125	10	0.1μ	6	1m	60~320	6	1m	320	

Continued on nex page.

HIGH FREQUENCY APPLICATIONS

Continued from preceding page.

Type Number	Page	Case		Applications	Absolute Maximum Ratings/Ta=25°C						Electrical Characteristics/Ta=25°C							
		Package	Package No.		V _{CB0}	V _{CE0} *V _{CER}	V _{EB0}	I _C	P _C	T _J	I _{CB0}		h _{FE}		f _T			
					[V]	[V]	[V]	[A]	[W]	[°C]	V _{CB} , [V]	(max) [A]	V _{CE} [V]	I _C [A]		V _{CE} [V]	I _C [A]	[MHz]
2SC930	247	SP	2000B	AM Conv., FM RF, IF Amp.	30	20	5	30m	120m	125	10	1.0μ	6	1m	40~320	6	1m	300
2SA1177	87	SP	2000B	HF Amp.	30	20	5	30m	150m	125	10	0.1μ	6	1m	60~320	6	1m	230
					V _{GD0} , V _{GD5} *			I _G	P _D		V _{GS}	I _{GSS}	V _{DS}		I _{DSS}	V _{DS}	c _{rss}	
2SK212	952	SP	2002B	FM Tuner	20	-	-	10m	200m	125	0.5	10n	5	-	0.6~12mA	5	-	0.04pF
2SK315	972	SP	2002B	FM Tuner	20	-	-	10m	200m	125	0.5	10n	5	-	2.5~24mA	5	-	0.08pF
					V _{DS}			I _D			V _{GS}	I _{GSS}	V _{DS}	-	I _{DSS}		I _{YfsI}	
2SK544	1019	SP	2034	MOS FET for FM RF	20	-	-	20m	200m	125	±5V	10n	10	-	1.2~12.0	10	-	11mS
2SK427	994	SPA	2034	AM tuner	15	-	-	10m	200m	125	10	1.0n	5	-	1.2~12mA	5	-	17mS
2SK444	1009	SPA	2034	Video Camera 1st Stage	15*	-	-	10m	200m	125	10	1.0n	5	-	5~38mA	5	-	30mS
3SK107	1027	DP4A	2031A	HF Amp.	V _{DS}	V _{G1S}	V _{G2S}	I _D			I _{YfsI} =17mS: V _{DS} =10V P _G =26dB, N _F =2.2dB: V _{DS} =10V, I _D =10mA, V _{G2S} =4V, f=100MHz							
					20	±7	±7	30m	250m	125								
2SC3000	338	NP	2003A	HF Amp.	30	20	5	30m	250m	125	10	0.1μ	6	1m	60~320	6	1m	320
2SC930	247	NP	2003A	AM Conv., FM RF, IF Amp.	30	20	5	30m	250m	125	10	1.0μ	6	1m	40~320	6	1m	300
2SC2210	272	NP	2003A	AM RF Amp., Conv.	30	20	5	30m	250m	125	10	0.1μ	6	1m	40~320	6	1m	90
					V _{GD5}			I _G	P _D		V _{GS}	I _{GSS}	V _{DS}		I _{DSS}	V _{DS}	I _{YfsI}	
2SK41	943	NP	2005A	FM RF Amp., Conv.	18	-	-	10m	200m	125	1.0	10n	10	-	0.6~24mA	-	-	-
2SK445	1012	NP	2005A	Video Camera 1st Stage	15	-	-	10m	300m	125	10	1.0n	5	-	5~38mA	5	-	30mS
2SK493	1015	NP	2005A	Video Camera 1st Stage	15	-	-	10m	300m	125	10	1.0n	5	-	5~38mA	5	-	27mS
2SC2314	284	TO126	2009	27MHz CB Transceiver Driver	75	45	5	1	750m	150	40	1.0μ	5	500m	60~320	10	50m	250
2SC2078	269	TO220	2010A	27MHz CB Transceiver Driver	80	*75	5	3	10	150	40	10μ	5	500m	25~200	10	0.1	150
						(150Ω)					(T _c =50°C)							

LOW NOISE APPLICATIONS

(Classified by package and arranged in order of increasing P_C. Minus sign for PNP is omitted due to space limitations.)

Type Number	Page	Case		Applications	Absolute Maximum Ratings/Ta=25°C						Electrical Characteristics/Ta=25°C							
		Package	Package No.		V _{CB0}	V _{CE0}	V _{EB0}	I _C	P _C	T _J	I _{CB0}		h _{FE}			f _T		
					[V]	[V]	[V]	[A]	[W]	[°C]	V _{CB}	(max)	V _{CE}	I _C	V _{CE}	I _C	[MHz]	
					[V]	[V]	[V]	[A]	[W]	[°C]	[V]	[A]	[V]	[A]	[V]	[A]	[MHz]	
2SA1238	100	DP6A, B	2029A 2030A	Diff. Amp.	55	50	5	150m	200m	150	35	0.1μ	6	1m	100~560	6	1m	100
2SC3065	357	DP6A, B	2029A 2030A	Diff. Amp.	55	50	5	150m	200m	150	35	0.1μ	6	1m	100~960	6	1m	100
2SA1240	105	DP6A, B	2029A 2030A	Diff. Amp.	130	120	5	50m	200m	150	80	0.1μ	6	1m	160~560	6	1m	110
2SC3067	362	DP6A, B	2029A 2030A	Diff. Amp.	130	120	5	50m	200m	150	80	0.1μ	6	1m	160~960	6	1m	130
2SK332	976	DP6A, B	2027A 2028A	Diff. Amp.	V _{DS}	V _{GS}		I _G	P _D		V _{GS}	I _{GSS}	V _{DS}		I _{DSS}	V _{DS}		I _{YfsI}
					40	40	-	10m	200m	125	20	1.0n	10	-	1.2~12mA	10	-	17mS
2SC693	245	NP	2003A	Low Noise AF Amp.	40	20	5	50m	100m	125	35	1.0μ	6	1m	160~960	6	1m	100
2SA930	81	NP	2003A	Very Low Noise Amp.	40	35	5	50m	200m	125	30	0.1μ	6	1m	160~960	6	1m	80
2SC1571	264	NP	2003A	Very Low Noise Amp.	40	35	5	100m	200m	125	18	0.1μ	6	1m	160~960	6	1m	100
2SC1571L	264	NP	2003A	Very Low Noise Amp.	40	35	5	100m	200m	125	18	0.1μ	6	1m	160~960	6	1m	100
2SA929	81	NP	2003A	Very Low Noise Amp.	55	50	5	50m	200m	125	30	0.1μ	6	1m	160~960	6	1m	80

2SC1570	264	NP	2003A	Very Low Noise Amp.	55	50	5	100m	200m	125	18	0.1μ	6	1m	160~960	6	1m	100
*2SA1391	—	NP	—	Very Low Noise Amp.	50	50	5	200m	400m	125	80	1.0μ	6	1m	160~960	6	1m	130
2SC3382	486	NP	2003A	Very Low Noise Amp.	50	50	5	200m	400m	125	80	1.0μ	6	1m	160~190	6	1m	130
2SA1016	86	NP	2003A	High Voltage Amp.	120	100	5	50m	400m	125	80	1.0μ	6	1m	160~960	6	1m	110
2SC2362	289	NP	2003A	High Voltage Amp.	120	100	5	50m	400m	125	80	1.0μ	6	1m	160~960	6	1m	130
2SA1016K	86	NP	2003A	High Voltage Amp.	150	120	5	50m	400m	125	80	1.0μ	6	1m	160~960	6	1m	110
2SC2362K	289	NP	2003A	High Voltage Amp.	150	120	5	50m	400m	125	80	1.0μ	6	1m	160~960	6	1m	130
2SK222	956	NP	2019A	AF Low Noise Amp.	V _{DSS}	V _{GS}	I _G	P _D	V _{GS}	I _{GSS}	V _{DSS}	I _{DSS}	V _{DSS}	I _{Yfs1}				
					40	40	—	10m	300m	125	20	10n	10	—	0.6~12mA	10	—	17ms

TRANSISTORS WITH RESISTOR BUILT IN

(Classified by package and arranged in order of increasing P_c. Minus sign for PNP is omitted due to space limitations.)

Type Number	Page	Case		Applications	Absolute Maximum Ratings/Ta=25°C						Electrical Characteristics/Ta=25°C									
		VCB0	VCE0		VEB0	IC	PC	Tj	ICB0		hFE			fT						
									VCB	(max)	VCE	IC		VCE	IC					
		Package	Package No.		[V]	[V]	[V]	[A]	[W]	[°C]	[V]	[A]	[V]	[A]		[V]	[A]	[MHz]		
2SD1161	799	CP	2018	Piezoelectric Buzzer Driver	30	15	5	30mA	150mW	150	15	0.1μ	6	1mA	90~400	6	1mA	100		
2SA1341	130	CP	2018	Switching(R1=47k, R2=47k)	50	50	10	100mA	200mW	150	40	0.1μ	5	5mA	>50	10	5mA	200		
2SA1342	132	CP	2018	Switching(R1=22k, R2=22k)	50	50	10	100mA	200mW	150	40	0.1μ	5	5mA	>50	10	5mA	200		
2SA1343	134	CP	2018	Switching(R1=46k, R2=23k)	50	50	10	100mA	200mW	150	40	0.1μ	5	5mA	>50	10	5mA	200		
2SA1344	136	CP	2018	Switching(R1=10k, R2=10k)	50	50	10	100mA	200mW	150	40	0.1μ	5	5mA	>50	10	5mA	200		
2SC3395	500	CP	2018	Switching(R1=47k, R2=47k)	50	50	10	100mA	200mW	150	40	0.1μ	5	5mA	>50	10	5mA	250		
2SC3396	502	CP	2018	Switching(R1=22k, R2=22k)	50	50	10	100mA	200mW	150	40	0.1μ	5	5mA	>50	10	5mA	250		
2SC3397	504	CP	2018	Switching(R1=46k, R2=23k)	50	50	10	100mA	200mW	150	40	0.1μ	5	5mA	>50	10	5mA	250		
2SC3398	506	CP	2018	Switching(R1=10k, R2=10k)	50	50	10	100mA	200mW	150	40	0.1μ	5	5mA	>50	10	5mA	250		
2SA1345	138	SPA	2033	Switching(R1=47k, R2=47k)	50	50	10	100mA	300mW	150	40	0.1μ	5	5mA	>50	10	5mA	200		
2SA1346	140	SPA	2033	Switching(R1=22k, R2=22k)	50	50	10	100mA	300mW	150	40	0.1μ	5	5mA	>50	10	5mA	200		
2SA1347	142	SPA	2033	Switching(R1=46k, R2=23k)	50	50	10	100mA	300mW	150	40	0.1μ	5	5mA	>50	10	5mA	200		
2SA1348	144	SPA	2033	Switching(R1=10k, R2=10k)	50	50	10	100mA	300mW	150	40	0.1μ	5	5mA	>50	10	5mA	200		
2SC3399	508	SPA	2033	Switching(R1=47k, R2=47k)	50	50	10	100mA	300mW	150	40	0.1μ	5	5mA	>50	10	5mA	250		
2SC3400	510	SPA	2033	Switching(R1=22k, R2=22k)	50	50	10	100mA	300mW	150	40	0.1μ	5	5mA	>50	10	5mA	250		
2SC3401	512	SPA	2033	Switching(R1=46k, R2=23k)	50	50	10	100mA	300mW	150	40	0.1μ	5	5mA	>50	10	5mA	250		
2SC3402	514	SPA	2033	Switching(R1=10k, R2=10k)	50	50	10	100mA	300mW	150	40	0.1μ	5	5mA	>50	10	5mA	250		
2SA1420	167	NP	2003A	Switching(R1=47k, R2=47k)	50	50	10	100mA	400mW	150	40	0.1μ	5	5mA	>50	10	5mA	200		
2SA1421	169	NP	2003A	Switching(R1=22k, R2=22k)	50	50	10	100mA	400mW	150	40	0.1μ	5	5mA	>50	10	5mA	200		
2SA1422	171	NP	2003A	Switching(R1=46k, R2=23k)	50	50	10	100mA	400mW	150	40	0.1μ	5	5mA	>50	10	5mA	200		
2SA1423	173	NP	2003A	Switching(R1=10k, R2=10k)	50	50	10	100mA	400mW	150	40	0.1μ	5	5mA	>50	10	5mA	200		
2SC3653	676	NP	2003A	Switching(R1=47k, R2=47k)	50	50	10	100mA	400mW	150	40	0.1μ	5	5mA	>50	10	5mA	250		
2SC3654	678	NP	2003A	Switching(R1=22k, R2=22k)	50	50	10	100mA	400mW	150	40	0.1μ	5	5mA	>50	10	5mA	250		
2SC3655	680	NP	2003A	Switching(R1=46k, R2=23k)	50	50	10	100mA	400mW	150	40	0.1μ	5	5mA	>50	10	5mA	250		
2SC3656	682	NP	2003A	Switching(R1=10k, R2=10k)	50	50	10	100mA	400mW	150	40	0.1μ	5	5mA	>50	10	5mA	250		

HIGH VOLTAGE APPLICATIONS

(Classified by package and arranged in order of increasing P_c . Minus sign for PNP is omitted due to space limitations.)

● : Mounted on ceramic board (250mm²×0.8mm)

Type Number	Page	Case		Applications	Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$						Electrical Characteristics/ $T_a=25^{\circ}\text{C}$								
		VCB0	VCE0		VEB0	IC	PC * $T_C=25^{\circ}\text{C}$ Pd	TJ [$^{\circ}\text{C}$]	ICB0		hFE			fT					
									VCB [V]	(max) [A]	VCE [V]	IC [A]		VCE [V]	IC [A]	[MHz]			
2SK333	979	DP6A, B	2027A 2028A	Diff. Amp.	VDS 80	VGS 80	-	IG 10m	Pd 200m	125	VGS 30	IGSS 1.0n	VDS 30	-	IDSS 1.2~12m	VDS 30	-	ciss 11pF	
2SA1415	164	PCP	2038	High Voltage Switching	180	160	5	140m	1.3●	150	80	0.1μ	5	10m	100~400	10	10m	150	
2SC3645	664	PCP	2038	High Voltage Switching	180	160	5	140m	1.3●	150	80	0.1μ	5	10m	100~400	10	10m	150	
2SA1418	165	PCP	2038	High Voltage Switching	180	160	5	0.7	1.3●	150	120	0.1μ	5	100m	100~400	10	50m	120	
2SC3648	667	PCP	2038	High Voltage Switching	180	160	5	0.7	1.3●	150	120	0.1μ	5	100m	100~400	10	50m	120	
*2SA1419	—	PCP	2038	High Voltage Switching	180	160	5	1.5	1.5●	150	120	0.1μ	5	100m	100~400	10	50m	120	
*2SC3649	—	PCP	2038	High Voltage Switching	180	160	5	1.5	1.5●	150	120	0.1μ	5	100m	100~400	10	50m	120	
2SC2857	312	NP	2003A	High Voltage Driver	180	180	5	59m	500m	150	180	1.0μ	10	10m	40~320	30	10m	>50	
2SA1207	93	NP	2003A	High Voltage Switching AF 60W Amp. Predriver	180	160	5	70m	600m	150	80	0.1μ	5	10m	100~400	10	10m	150	
2SC2909	315	NP	2003A	High Voltage Switching AF 60W Amp. Predriver	180	160	5	70m	600m	150	80	0.1μ	5	10m	100~400	10	10m	150	
2SA1319	125	NP	2003A	High Voltage Switching	180	160	6	0.7	700m	150	120	0.1μ	5	100m	100~400	-	-	-	
2SC3332	481	NP	2003A	High Voltage Switching	180	160	6	0.7	700m	150	120	0.1μ	5	100m	100~400	-	-	-	
2SK223	958	NP	2019A	High Voltage Driver	VDS 80	VGS 80	-	IG 10m	Pd 400m	125	VGS 30	IGSS 1.0n	VDS 30	-	IDSS 1.2~24mA	VDS 30	-	ciss 12pF	
2SA1208	94	MP	2006A	High Voltage Switching AF 80W Amp. Predriver	180	160	5	70m	900m	150	80	0.1μ	5	10m	100~400	10	10m	150	
2SC2910	318	MP	2006A	High Voltage Switching AF 80W Amp. Predriver	180	160	5	70m	900m	150	80	0.1μ	5	10m	100~400	10	10m	150	
2SA1209	95	TO126	2009	High Voltage Switching AF 100W Amp. Predriver	180	160	5	140m	10*	150	80	0.1μ	5	10m	100~400	10	10m	150	
2SC2911	321	TO126	2009	High Voltage Switching AF 100W Amp. Predriver	180	160	5	140m	10*	150	80	0.1μ	5	10m	100~400	10	10m	150	
2SA1248	109	TO126	2009	High Voltage Switching	180	160	6	0.7	10*	150	120	0.1μ	5	100m	100~400	10	50m	120	
2SC3116	401	TO126	2009	High Voltage Switching	180	160	6	0.7	10*	150	120	0.1μ	5	100m	100~400	10	50m	120	
2SA1249	110	TO126	2009	High Voltage Switching	180	160	6	1.5	10*	150	120	1.0μ	5	100m	100~400	10	50m	120	
2SC3117	404	TO126	2009	High Voltage Switching	180	160	6	1.5	10*	150	120	1.0μ	5	100m	100~400	10	50m	120	
2SA1210	96	TO126	2009	High Voltage Switching AF 150W Amp. Predriver	200	200	5	140m	10*	150	160	0.1μ	5	10m	100~400	10	10m	150	
2SC2912	324	TO126	2009	High Voltage Switching AF 150W Amp. Predriver	200	200	5	140m	10*	150	160	0.1μ	5	10m	100~400	10	10m	150	

LOW SATURATION VOLTAGE APPLICATIONS

(Classified by package and arranged in order of increasing V_{CE0} , I_C . Minus sign for PNP is omitted due to space limitations.)

Type Number	Page	Case		Applications	Absolute Maximum Ratings/Ta=25°C					Electrical Characteristics/Ta=25°C								
		Package	Package No.		VCE0	VCE0	IC	PC	TJ	VCE(sat)			hFE			fT		
										*TC=25°C	IC	IB	max	VCE	IC		VCE	IC
					[V]	[V]	[A]	[W]	[°C]	[A]	[A]	[V]	[V]	[A]		[V]	[A]	[MHz]
2SB815	194	CP	2018	AF Power Amp.	20	15	0.7	200m	125	5m	0.5m	15m	2	50m	200~600	10	50m	250
2SD1048	770	CP	2018	AF Power Amp.	20	15	0.7	200m	125	5m	0.5m	10m	2	50m	200~900	10	50m	250
2SB1118	231	PCP	2038	Converter, Switching	20	15	0.7	1.3	-	5m	0.5m	15m	2	50m	140~800	10	50m	250
2SD1618	894	PCP	2038	Converter, Switching	20	15	0.7	1.3	-	5m	0.5m	10m	2	50m	140~800	10	50m	250
2SB1119	232	PCP	2038	Switching, Driver	25	25	1	1.3	-	500m	50m	0.15	2	50m	100~560	10	50m	180
2SD1619	897	PCP	2038	Switching, Driver	25	25	1	1.3	-	500m	50m	0.1	2	50m	100~560	10	50m	180
2SB1120	233	PCP	2038	Strobe (3V max)	20	10	2.5	1.3	-	1.5	150m	0.25	2	500m	100~560	10	50m	250
2SD1620	900	PCP	2038	Strobe (3V max)	30	10	3	1.3	-	3	60m	0.3	2	3	>140	10	50m	200
2SB1121	236	PCP	2038	Large Current Switching	30	25	2	1.3	-	1.5	75m	0.35	2	100m	100~560	10	50m	150
2SD1621	903	PCP	2038	Large Current Switching	30	25	2	1.3	-	1.5	75m	0.18	2	100m	100~560	10	50m	150
*2SB1122	—	PCP	2038	Large Current Switching	60	50	1	1.3	-	500m	50m	0.2	2	50m	60~320	10	50m	150
*2SD1622	—	PCP	2038	Large Current Switching	60	50	1	1.3	-	500m	50m	0.15	2	50m	60~320	10	50m	150
2SB1123	238	PCP	2038	Large Current Switching	60	50	2	1.3	-	1	50m	0.3	2	100m	100~560	10	50m	150
2SD1623	906	PCP	2038	Large Current Switching	60	50	2	1.3	-	1	50m	0.15	2	100m	100~560	10	50m	150
*2SB1124	—	PCP	2038	Large Current Switching	60	50	3	1.5	-	2	100m	0.35	2	100m	100~560	10	50m	150
*2SD1624	—	PCP	2038	Large Current Switching	60	50	3	1.5	-	2	0.1	0.19	2	100m	100~560	10	50m	150
2SD1628	913	PCP	2038	Strobe (6V max)	60	20	5	1.5	-	3	60m	0.5	2	500m	120~560	10	50m	120
2SB808	193	SP	2000B	AF Power Amp.	20	15	0.7	200m	125	5m	0.5m	10m	2	50m	200~900	10	50m	250
2SD1012	760	SP	2000B	AF Power Amp.	20	15	0.7	250m	125	5m	0.5m	10m	2	50m	160~960	10	50m	250
2SB893	215	NP	2003A	Large Current Driver	20	10	2.5	750m	150	1.5	0.15	0.25	2	500m	100~560	10	50m	250
2SD879	748	NP	2003A	Electronic Flash	30	10	3.0	750m	150	3.0	60m	0.3	2	3	210	10	50m	200
2SB698	188	NP	2003A	AF Power Amp.	25	20	0.7	600m	150	500m	50m	0.2	2	50m	60~560	10	50m	250
2SD734	736	NP	2003A	AF Power Amp.	25	20	0.7	600m	150	500m	50m	0.13	2	50m	60~560	10	50m	250
2SB598	183	NP	2003A	AF Power Amp.	25	25	1.0	600m	150	500m	50m	0.15	2	50m	60~320	10	50m	180
2SD545	719	NP	2003A	AF Power Amp.	25	25	1.0	600m	150	500m	50m	0.1	2	50m	60~320	10	50m	180
2SB926	226	NP	2003A	Large Current Switching	30	25	2.0	750m	150	1.5	75m	0.35	2	100m	100~560	10	50m	150
2SD1246	849	NP	2003A	Large Current Switching	30	25	2.0	750m	150	1.5	75m	0.18	2	100m	100~560	10	50m	150
2SD1145	792	MP	2006A	Large Current Driver	60	20	5.0	900m	150	3.0	60m	0.5*	2	500m	100~560	10	50m	120
2SB544	180	MP	2006A	AF Power Amp.	25	25	1.0	900m	150	500m	50m	0.15	2	50m	60~560	10	50m	180
2SD400	707	MP	2006A	AF Power Amp.	25	25	1.0	900m	150	500m	50m	0.1	2	50m	60~560	10	50m	180
2SB927	227	MP	2006A	Large Current Switching	30	25	2.5	1	150	1.5	75m	0.35	2	100m	100~560	10	50m	150
2SD1247	852	MP	2006A	Large Current Switching	30	25	2.5	1	150	1.5	75m	0.18	2	100m	100~560	10	50m	150
2SB764	189	MP	2006A	Voltage Regulator	60	50	1.0	900m	150	500m	50m	0.2	2	50m	60~320	10	50m	150
2SD863	745	MP	2006A	Voltage Regulator	60	50	1.0	900m	150	500m	50m	0.15	2	50m	60~320	10	50m	150

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LOW SATURATION VOLTAGE APPLICATIONS Continued from preceding page.

Type Number	Page	Case		Applications	Absolute Maximum Ratings/Ta=25°C					Electrical Characteristics/Ta=25°C									
		Package	Package No.		V _{CE0}	V _{CE0}	I _C	P _C	T _J	V _{CE(sat)}			h _{FE}			f _T			
					[V]	[V]	[A]	*T _C =25°C [W]	[°C]	I _C	I _B	*max [V]	V _{CE}	I _C		V _{CE}	I _C	[MHz]	
2SB892	214	MP	2006A	Large Current Switching	60	50	2.0	1	150	1.0	50m	0.3	2	100m	100~560	10	50m	150	
2SD1207	822	MP	2006A	Large Current Switching	60	50	2.0	1	150	1.0	50m	0.15	2	100m	100~560	10	50m	150	
2SB985	228	MP	2006A	Large Current Switching	60	50	3.0	1	150	2.0	100m	0.35	2	100m	100~560	10	50m	150	
2SD1347	855	MP	2006A	Large Current Switching	60	50	3.0	1	150	2.0	100m	0.19	2	100m	100~560	10	50m	150	
2SB559	181	TO126	2009	AF Power Amp.	20	18	1.2	8	150	1.0	50m	0.35	2	500m	60~320	10	50m	150	
2SD439	715	TO126	2009	AF Power Amp.	20	18	1.2	8*	150	1.0	50m	0.25	2	500m	60~320	10	50m	150	
*2SB1127	—	TO126	2009	Large Current Switching	25	20	5.0	10	150	3.0	60m	0.5	2	500m	100~400	5	200m	300	
2SD826	741	TO126	2009	Large Current Switching	60	20	5.0	10*	150	3.0	60m	0.5*	2	500m	120~560	10	50m	120	
2SB986	229	TO126	2009	Large Current Switching	60	50	4.0	10*	150	2.0	100m	0.35	2	100m	100~560	10	50m	150	
2SD1348	858	TO126	2009	Large Current Switching	60	50	4.0	10*	150	2.0	100m	0.19	2	100m	100~560	10	50m	150	
2SB919	222	TO220	2010A	Large Current Switching	60	30	8.0	30*	150	3.0	0.15	0.5*	2	1	70~280	5	1	120	
2SD1235	837	TO220	2010A	Large Current Switching	60	30	8.0	30*	150	3.0	0.15	0.4*	2	1	70~280	5	1	120	
2SB903	218	TO220	2010A	Large Current Switching	60	30	12	35*	150	5.0	0.25	0.5*	2	1	70~280	5	1	120	
2SD1212	825	TO220	2010A	Large Current Switching	60	30	12	35*	150	5.0	0.25	0.4*	2	1	70~280	5	1	120	
2SB824	197	TO220	2010A	Large Current Switching	60	50	5.0	30*	150	3.0	0.3	0.4*	2	1	70~280	5	1	30	
2SD1060	772	TO220	2010A	Large Current Switching	60	50	5.0	30*	150	3.0	0.3	0.4*	2	1	70~280	5	1	30	
2SB825	198	TO220	2010A	Large Current Switching	60	50	7.0	40*	150	4.0	0.4	0.4*	2	1	70~280	5	1	10	
2SD1061	775	TO220	2010A	Large Current Switching	60	50	7.0	40*	150	4.0	0.4	0.4*	2	1	70~280	5	1	10	
2SB826	199	TO220	2010A	Large Current Switching	60	50	12	40*	150	6.0	0.3	0.5*	2	1	70~280	5	1	10	
2SD1062	778	TO220	2010A	Large Current Switching	60	50	12	40*	150	6.0	0.3	0.4*	2	1	70~280	5	1	10	
2SA1289	120	TO220	2010A	Large Current Switching	80	60	5.0	30*	150	2.5	0.125	0.4*	2	1	70~280	5	1	100	
2SC3253	454	TO220	2010A	Large Current Switching	80	60	5.0	30*	150	2.5	0.125	0.4*	2	1	70~280	5	1	100	
2SA1290	121	TO220	2010A	Large Current Switching	80	60	7.0	35*	150	3.5	0.175	0.4*	2	1	70~280	5	1	100	
2SC3254	457	TO220	2010A	Large Current Switching	80	60	7.0	35*	150	3.5	0.175	0.4*	2	1	70~280	5	1	100	
2SA1291	122	TO220	2010A	Large Current Switching	80	60	10	40*	150	5.0	0.25	0.4*	2	1	70~280	5	1	100	
2SC3255	460	TO220	2010A	Large Current Switching	80	60	10	40*	150	5.0	0.25	0.4*	2	1	70~280	5	1	100	
2SB920L	223	TO220	2010A	Large Current Switching	90	80	5.0	30*	150	3.0	0.3	0.5*	2	1	70~280	5	1	20	
2SD1236L	840	TO220	2010A	Large Current Switching	90	80	5.0	30*	150	3.0	0.3	0.4*	2	1	70~280	5	1	20	
2SB921L	224	TO220	2010A	Large Current Switching	90	80	7.0	40*	150	4.0	0.4	0.5*	2	1	70~280	5	1	20	
2SD1237L	843	TO220	2010A	Large Current Switching	90	80	7.0	40*	150	4.0	0.4	0.4*	2	1	70~280	5	1	20	
2SB904	219	TO3PB	2022	Large Current Switching	60	30	20	60*	150	8.0	0.4	0.5*	2	1	70~280	5	1	120	
2SD1213	828	TO3PB	2022	Large Current Switching	60	30	20	60*	150	8.0	0.4	0.4*	2	1	70~280	5	1	120	
2SB827	200	TO3PB	2022	Large Current Switching	60	50	7.0	60*	150	4.0	0.4	0.4*	2	1	70~280	5	1	10	
2SD1063	781	TO3PB	2022	Large Current Switching	60	50	7.0	60*	150	4.0	0.4	0.4*	2	1	70~280	5	1	10	
2SB828	201	TO3PB	2022	Large Current Switching	60	50	12	80*	150	6.0	0.3	0.5*	2	1	70~280	5	1	10	
2SD1064	784	TO3PB	2022	Large Current Switching	60	50	12	80*	150	6.0	0.3	0.4*	2	1	70~280	5	1	10	
2SB829	202	TO3PB	2022	Large Current Switching	60	50	15	90*	150	8.0	0.4	0.5*	2	1	70~280	5	1	20	
2SD1065	787	TO3PB	2022	Large Current Switching	60	50	15	90*	150	8.0	0.4	0.4*	2	1	70~280	5	1	20	
2SA1292	—	TO3PB	2022	Large Current Switching	80	60	15	70	150	7.5	0.375	0.4*	2	1	70~280	5	1	100	
2SC3256	—	TO3PB	2022	Large Current Switching	80	60	15	70	150	7.5	0.375	0.4*	2	1	>70	5	1	100	

2SB922L	225	TO3PB	2022	Large Current Switching	90	80	12	80*	150	6.0	0.6	0.5*	2	1	70~280	5	1	20
2SD1238L	846	TO3PB	2022	Large Current Switching	90	80	12	80*	150	6.0	0.6	0.4*	2	1	70~280	5	1	20

DARLINGTON TRANSISTORS

(Classified by package and arranged in order of increasing V_{CE0} , I_C . Minus sign for PNP is omitted due to space limitations.)

● : Mounted on ceramic board (250mm²×0.8mm), ☆ : With Zener diode (60±10V)

Type Number	Page	Case		Applications	Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$							Electrical Characteristics/ $T_a=25^{\circ}\text{C}$								
		VCE0	VCE0		VEB0	IC	PC *TC=25°C	TJ	ICB0		hFE			fT						
									VCE	(max)	VCE	IC		VCE	IC	fT				
		Package	Package No.		[V]	[V]	[V]	[A]	[W]	[°C]	[V]	[A]	[V]	[A]		[V]	[A]	[MHz]		
*2SD1627	—	PCP	2038	General Drivers	30	25	10	2.0	1.5●	150	20	1.0μ	2	500m	>4000	10	50m	120		
*2SB1125	—	PCP	2038	General Drivers	80	50	10	0.7	1.3●	150	40	0.1μ	2	50m	>5000	5	50m	170		
*2SD1625	—	PCP	2038	General Drivers	80	50	10	0.7	1.3●	150	40	0.1μ	2	50m	>5000	5	50m	200		
2SB1126	240	PCP	2038	General Drivers	80	50	10	1.5	1.5●	150	40	0.1μ	2	500m	>4000	10	50m	120		
2SD1626	910	PCP	2038	General Drivers	80	50	10	1.5	1.5●	150	40	0.1μ	2	500m	>4000	10	50m	120		
2SB888	212	NP	2003A	General Drivers	80	50	10	0.7	600m	150	40	0.1μ	2	50m	>5000	5	50m	170		
2SD1111	790	NP	2003A	General Drivers	80	50	10	0.7	600m	150	40	0.1μ	2	50m	>5000	5	50m	200		
2SB865	203	MP	2006A	General Drivers	80	50	10	1.5	900m	150	40	0.1μ	2	500m	>4000	10	50m	120		
2SD1153	794	MP	2006A	General Drivers	80	50	10	1.5	900m	150	40	0.1μ	2	500m	>4000	10	50m	120		
2SD894	751	TO126	2009	General Drivers	30	25	10	1.5	10*	150	20	1.0μ	2	500m	>4000	10	50m	120		
2SC3705	—	TO126	2000	General Drivers	30☆	30☆	10	1.2	10	150	20	1.0μ	2	500m	>4000	10	50m	120		
2SC3292	466	TO220	2010A	High-Speed Drivers (With C-B Zener diode)	50☆	50☆	6	1.2	20*	150	40	0.1m	5	1.0	>1000	5	1.0	180		
2SC3293	469	TO220	2010A	High-Speed Drivers (With C-B Zener diode)	50☆	50☆	6	2.0	25*	150	40	0.1m	5	1.0	>1000	5	1.0	180		
2SC3294	472	TO220	2010A	High-Speed Drivers (With C-B Zener diode)	50☆	50☆	6	3.0	25*	150	40	0.1m	5	1.5	>1000	5	1.5	180		
2SD1393	—	TO220	2010A	General Drivers (With C-B Zener diode)	50☆	50☆	6	1.5	30	150	40	0.1m	5	0.75	>1000	5	1.0	180		
2SD1394	861	TO220	2010A	General Drivers (With C-B Zener diode)	50☆	50☆	6	3.0	30*	150	40	0.1m	5	1.5	>1000	5	1.0	180		
2SD1395	864	TO220	2010A	General Drivers (With C-B Zener diode)	50☆	50☆	6	5.0	40*	150	40	0.1m	3	2.5	>1000	5	2.5	180		
2SA1258	118	TO220	2010A	High-Speed Drivers	70	60	5	3.0	20*	150	40	0.1m	2	1.5	5000	5	1.5	200		
2SC3144	417	TO220	2010A	High-Speed Drivers	70	60	5	3.0	20*	150	40	0.1m	2	1.5	5000	5	1.5	200		
2SB880	204	TO220	2010A	General Drivers	70	60	6	4.0	30*	150	40	0.1m	2	2.0	5000	5	2.0	20		
2SD1190	800	TO220	2010A	General Drivers	70	60	6	4.0	30*	150	40	0.1m	2	2.0	5000	5	2.0	20		
2SA1259	119	TO220	2010A	High-Speed Drivers	70	60	5	5.0	30*	150	40	0.1m	2	2.5	5000	5	2.5	200		
2SC3145	420	TO220	2010A	High-Speed Drivers	70	60	5	5.0	30*	150	40	0.1m	2	2.5	5000	5	2.5	200		
2SB881	205	TO220	2010A	General Drivers	70	60	6	7.0	35*	150	40	0.1m	2	3.5	5000	5	3.5	20		
2SD1191	803	TO220	2010A	General Drivers	70	60	6	7.0	35*	150	40	0.1m	2	3.5	5000	5	3.5	20		
2SB882	206	TO220	2010A	General Drivers	70	60	6	10	40*	150	40	0.1m	2	5.0	5000	5	5.0	20		
2SD1192	806	TO220	2010A	General Drivers	70	60	6	10	40*	150	40	0.1m	2	5.0	5000	5	5.0	20		
2SB884	208	TO220	2010A	General Drivers	110	100	6	3.0	30*	150	80	0.1m	3	1.5	4000	5	1.5	20		

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Type Number	Page	Case		Applications	Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$						Electrical Characteristics/ $T_a=25^{\circ}\text{C}$							
		VCB0	VCE0		VEB0	IC	PC * $T_C=25^{\circ}\text{C}$	TJ	ICB0			hFE			fT			
									VCB [V]	(max) [A]	VCE [V]	IC [A]		VCE [V]	IC [A]		[MHz]	
2SD1194	812	TO220	2010A	General Drivers	110	100	6	3.0	30*	150	80	0.1m	3	1.5	4000	5	1.5	20
2SB885	209	TO220	2010A	General Drivers	110	100	6	5.0	35*	150	80	0.1m	3	2.5	4000	5	2.5	20
2SD1195	815	TO220	2010A	General Drivers	110	100	6	5.0	35*	150	80	0.1m	3	2.5	4000	5	2.5	20
2SB886	210	TO220	2010A	General Drivers	110	100	6	8.0	40*	150	80	0.1m	3	4.0	4000	5	4.0	20
2SD1196	818	TO220	2010A	General Drivers	110	100	6	8.0	40*	150	80	0.1m	3	4.0	4000	5	4.0	20
2SB912	220	TO3PB	2022	General Drivers	70	60	6	10	60*	150	40	0.1m	2	5.0	5000	5	5.0	20
2SD1229	831	TO3PB	2022	General Drivers	70	60	6	10	60*	150	40	0.1m	2	5.0	5000	5	5.0	20
2SB883	207	TO3PB	2022	General Drivers	70	60	6	15	70*	150	40	0.1m	2	7.0	5000	5	7.0	20
2SD1193	809	TO3PB	2022	General Drivers	70	60	6	15	70*	150	40	0.1m	2	7.0	5000	5	7.0	20
2SB887	211	TO3PB	2022	General Drivers	110	100	6	10	70	150	80	0.1m	3	5.0	4000	5	5.0	20
2SD1197	821	TO3PB	2022	General Drivers	110	100	6	10	70	150	80	0.1m	3	5.0	4000	5	5.0	20
2SB913	221	TO3PB	2022	General Drivers	110	100	6	8.0	60*	150	80	0.1m	3	4.0	4000	5	4.0	20
2SD1230	834	TO3PB	2022	General Drivers	110	100	6	8.0	60*	150	80	0.1m	3	4.0	4000	5	4.0	20

SWITCHING APPLICATIONS

(Classified by V_{CE0} and arranged in order of package. Minus sign for PNP is omitted due to space limitations.)

Type Number	Page	Case		Applications	Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$						Electrical Characteristics/ $T_a=25^{\circ}\text{C}$						
		Package	Package No.		V_{CE0} [V]	V_{CE0} [V]	V_{EB0} [V]	IC [A]	PC * $T_C=25^{\circ}\text{C}$ [W]	TJ [$^{\circ}\text{C}$]	hFE			fT			tf (max) (μs)
											VCE [V]	IC [A]		VCE [V]	IC [A]	[MHz]	
2SA1331	126	CP	2018	High-Speed Switching	60	50	5	150m	150m	125	6	1m	90~400	6	1m	100	0.2typ
2SC3361	484	CP	2018	High-Speed Switching	60	50	5	150m	150m	125	6	1m	90~600	6	1m	100	0.16typ
2SA1338	128	CP	2018	High-Speed Switching	60	50	5	500m	200m	150	5	10m	100~560	10	50m	200	-
2SC3392	492	CP	2018	High-Speed Switching	60	50	5	500m	200m	150	5	10m	100~560	10	50m	300	-
2SC2960	327	SP	2000B	High-Speed Switching	60	50	5	150m	250m	150	6	1m	100~560	6	1m	100	0.25
2SA1339	129	SPA	2033	High-Speed Switching	60	50	5	500m	300m	150	5	10m	100~560	10	50m	200	-
2SC3393	496	SPA	2033	High-Speed Switching	60	50	5	500m	300m	150	5	10m	100~560	10	50m	300	-
2SC2998	330	NP	2003A	High-Speed Switching	60	50	5	150m	500m	150	6	1m	100~560	6	1m	100	0.25
2SA1257	117	CP	2018	High-Voltage Switching	180	160	5	80m	200	125	5	10m	60~270	10	10m	130	0.15
2SC3143	416	CP	2018	High-Voltage Switching	180	160	5	80m	200	125	5	10m	60~270	10	10m	150	0.2
2SC3038	342	TO220	2010A	Switching Regulator	500	400	7	4	40*	150	5	0.4	>15	10	0.4	20	1.0
2SC3039	345	TO220	2010A	Switching Regulator	500	400	7	7	50*	150	5	0.8	>15	10	0.8	20	1.0
2SC3083	377	TO3PB	2022	Switching Regulator	500	400	7	6	60*	150	5	0.4	>15	10	0.4	20	1.0
2SC3040	348	TO3PB	2022	Switching Regulator	500	400	7	8	80*	150	5	0.8	>15	10	0.8	20	1.0
2SC3277	463	TO3PB	2022	Switching Regulator	500	400	7	10	90*	150	5	1.2	>15	10	1.2	20	1.0
2SC3042	351	TO3PB	2022	Switching Regulator	500	400	7	12	100*	150	5	1.6	>15	10	1.6	20	1.0
2SC3085	380	TO3	2017	Switching Regulator	500	400	7	25	160*	150	5	16	>8	10	3.2	20	1.0
2SC3086	383	TO220	2010A	Switching Regulator	800	500	7	3	40*	150	5	0.3	>10	10	0.3	18	1.0
2SC3446	524	TO220	2010A	Switching Regulator (High-Speed)	800	500	7	3	40*	150	5	0.3	>10	10	0.3	18	0.3
2SC3087	386	TO220	2010A	Switching Regulator	800	500	7	5	50*	150	5	0.6	>10	10	0.6	18	1.0

2SC3447	527	TO220	2010A	Switching Regulator (High-Speed)	800	500	7	5	50*	150	5	0.6	>10	10	0.6	18	0.3
2SC3088	389	TO3PB	2022	Switching Regulator	800	500	7	4	60*	150	5	0.3	>10	10	0.3	18	1.0
2SC3448	530	TO3PB	2022	Switching Regulator (High-Speed)	800	500	7	4	60*	150	5	0.3	>10	10	0.3	18	0.3
2SC3089	392	TO3PB	2022	Switching Regulator	800	500	7	7	80*	150	5	0.6	>10	10	0.6	18	1.0
2SC3449	533	TO3PB	2022	Switching Regulator (High-Speed)	800	500	7	7	80*	150	5	0.6	>10	10	0.6	18	0.3
2SC3450	536	TO3PB	2022	Switching Regulator (High-Speed)	800	500	7	10	90*	150	5	0.8	>10	10	0.8	18	0.3
2SC3090	395	TO3PB	2022	Switching Regulator	800	500	7	10	100*	150	5	1.2	>10	10	1.2	18	1.0
2SC3451	539	TO3PB	2022	Switching Regulator (High-Speed)	800	500	7	15	100*	150	5	1.2	>10	10	1.2	18	0.3
2SC3455	542	TO3	2017	Switching Regulator (High-Speed)	800	500	7	25	160*	150	5	12	>8	10	2.4	18	0.3
2SC3466	—	TO3PB	2022	Switching Regulator	1200	650	7	8.0	120	150	5	1.0	>10	10	1.0	5	0.7
2SC3183	446	TO220	2010A	Switching Regulator	900	800	7	0.2	25*	150	5	0.1	>8	10	20m	15	1.0
2SC3184	449	TO220	2010A	Switching Regulator	900	800	7	0.5	30*	150	5	0.3	>8	10	60m	15	1.0
2SC3149	423	TO220	2010A	Switching Regulator	900	800	7	1.5	40*	150	5	0.1	>10	10	0.1	15	0.7
2SC3456	545	TO220	2010A	Switching Regulator (High-Speed)	1100	800	7	1.5	40*	150	5	0.1	>10	10	0.1	15	0.3
2SC3150	426	TO220	2010A	Switching Regulator	900	800	7	3.0	50*	150	5	0.2	>10	10	0.2	15	0.7
2SC3457	548	TO220	2010A	Switching Regulator (High-Speed)	1100	800	7	3.0	50*	150	5	0.2	>10	10	0.2	15	0.3
2SC3151	429	TO3PB	2022	Switching Regulator	900	800	7	1.5	60*	150	5	0.1	>10	10	0.1	15	0.7
2SC3152	432	TO3PB	2022	Switching Regulator	900	800	7	3.0	80*	150	5	0.2	>10	10	0.2	15	0.7
2SC3458	551	TO3PB	2022	Switching Regulator (High-Speed)	1100	800	7	3.0	80*	150	5	0.2	>10	10	0.2	15	0.3
2SC3459	554	TO3PB	2022	Switching Regulator (High-Speed)	1100	800	7	4.5	90*	150	5	0.3	>10	10	0.3	15	0.3
2SC3153	435	TO3PB	2022	Switching Regulator	900	800	7	6.0	100*	150	5	0.4	>10	10	0.4	15	0.7
2SC3460	557	TO3PB	2022	Switching Regulator (High-Speed)	1100	800	7	6.0	100*	150	5	0.4	>8	10	0.4	15	0.3
2SC3461	560	TO3PB	2022	Switching Regulator (High-Speed)	1100	800	7	8.0	120*	150	5	0.8	>10	10	0.8	15	0.3
2SC3552	608	TO3PB	2022	Switching Regulator	1100	800	7	12	150*	150	5	0.8	>10	10	0.8	15	0.3
2SC3465	—	TO3	2017	Switching Regulator	1100	800	7	12	160	150	5	4.0	>8	10	0.8	15	0.3

TV/CRT DISPLAY APPLICATIONS(I)

(Classified by package and arranged in order of increasing P_c. Minus sign for PNP is omitted due to space limitation.)

Type Number	Page	Case		Applications	Absolute Maximum Ratings/ Ta = 25°C							Electrical Characteristics/ Ta = 25°C							
		Package	Package No.		V _{CB0}	V _{CE0}	V _{EB0}	I _C	P _C	T _J	I _{CB0}			h _{FE}			f _T		
					[V]	[V]	[V]	[A]	[W]	[°C]	V _{CB} [V]	(max) [A]	V _{CE} [V]	I _C [A]		V _{CE} [V]	I _C [A]	[MHz]	
2SC2857	312	NP	2003A	Color TV Ver., Sound Driver	180	180	5	50m	500m	150	180	1.0μ	10	10m	40~320	30	10m	>50	
2SC3504	606	MP	2006A	High-Definition CRT Display, Video Output	70	60	4	50m	900m	150	40	0.1μ	10	10m	60~320	10	10m	500	
2SC2228Y	276	MP	2006A	TV Video Output	160	160	5	50m	900m	150	160	1.0μ	10	10m	40~320	30	10m	>50	
2SC2228A	276	MP	2006A	TV Video Output	200	200	5	50m	900m	150	200	1.0μ	10	10m	40~320	30	10m	>50	
2SC2271	279	MP	2006A	Chroma Output, Hori Def. Driver	300	300	6	100m	900m	150	200	1.0μ	10	10m	40~200	30	10m	>50	
2SA1370	148	MP	2006A	High-Definition CRT Display, Video Output	200	200	5	100m	1	150	150	0.1μ	10	10m	40~320	30	10m	150	
2SC3467	563	MP	2006A	High-Definition CRT Display, Video Output	200	200	5	100m	1	150	150	0.1μ	10	10m	40~320	30	10m	150	
2SA1371	149	MP	2006A	High-Definition CRT Display, Video Output	300	300	5	100m	1	150	200	0.1μ	10	10m	40~320	30	10m	150	
2SC3468	567	MP	2006A	High-Definition CRT Display, Video Output	300	300	5	100m	1	150	200	0.1μ	10	10m	40~320	30	10m	150	
2SA1352	146	TO126	2009	High-Definition CRT Display, Video Output	200	200	5	100m	5*	150	150	0.1μ	10	10m	40~320	30	10m	70	

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TV/CRT DISPLAY APPLICATIONS(I) Continued from preceding page.

Type Number	Page	Case		Applications	Absolute Maximum Ratings/Ta=25°C						Electrical Characteristics/Ta=25°C							
		VCB0	VCE0		VEB0	IC	PC *TC=25°C	Tj [°C]	ICB0		hFE			fT				
									VCB [V]	(max) [A]	VCE [V]	IC [A]		VCE [V]	IC [A]	[MHz]		
2SC3416	516	TO126	2009	High-Definition CRT Display, Video Output	200	200	5	100m	5*	150	150	0.1μ	10	10m	40~320	30	10m	70
2SA1380	150	TO126	2009	High-Definition CRT Display, Video Output	200	200	5	100m	5*	150	150	0.1μ	10	10m	40~320	30	10m	150
2SC3502	598	TO126	2009	High-Definition CRT Display, Video Output	200	200	5	100m	5*	150	150	0.1μ	10	10m	40~320	30	10m	150
2SA1381	151	TO126	2009	High-Definition CRT Display, Video Output	300	300	5	100m	7*	150	200	0.1μ	10	10m	40~320	30	10m	150
2SC3503	602	TO126	2009	High-Definition CRT Display, Video Output	300	300	5	100m	7*	150	200	0.1μ	10	10m	40~320	30	10m	150
2SA1353	147	TO126	2009	High-Definition CRT Display, Video Output	300	300	5	100m	10*	150	200	0.1μ	10	10m	40~320	30	10m	70
2SC3417	520	TO126	2009	High-Definition CRT Display, Video Output	300	300	5	100m	10*	150	200	0.1μ	10	10m	40~320	30	10m	70
2SC2621	293	TO126	2009	High-Definition CRT Display, Video Output	300	300	6.5	200m	10*	150	200	1.0μ	10	10m	40~200	30	10m	>50
2SC3675	684	TO220	2010A	High-Voltage Amp, High-Voltage Switching	1500	900	5	100m	10*	150	900	10μ	5	10m	>30	10	10m	6
2SC1755	267	TO220	2010A	TV Chroma, Video, Sound Output	300	300	7	200m	15*	150	200	0.1μ	10	10m	40~200	30	10m	>50
2SC1756	267	TO220	2013	TV Chroma, Video, Sound Output	300	300	7	200m	15*	150	200	0.1μ	10	10m	40~200	30	10m	>50
2SC1757	267	TO220	2012	TV Chroma, Video, Sound Output	300	300	7	200m	15*	150	200	0.1μ	10	10m	40~200	30	10m	>50
2SC3676	687	TO220	2010A	High-Voltage Amp, High-Voltage Switching	1500	900	5	300m	20*	150	900	10μ	5	30m	>30	10	30m	6
2SB1037	230	TO220	2010A	Color TV Ver, Sound Output	150	150	5	1.5	30*	175	120	10μ	5	0.3	70~200	5	100m	15
2SD1459	891	TO220	2010A	Color TV Ver, Sound Output	150	150	5	1.5	30*	175	120	10μ	5	0.3	70~200	5	100m	8
2SA1011	85	TO220	2010A	AF 100W Amp. Driver	180	160	6	1.5	25*	150	120	10μ	5	300m	60~200	10	50m	100
2SC2344	286	TO220	2010A	AF 100W Amp. Driver	180	160	6	1.5	25*	150	120	10μ	5	300m	60~200	10	50m	100
2SD386A	705	TO220	2010A	TV Vertical Output	200	150	6	2.0	25*	150	180	1.0m	2	0.5	40~320	5	0.5	8
2SD387A	705	TO220	2012A	TV Vertical Output	200	150	6	2.0	25*	150	180	1.0m	2	0.5	40~320	5	0.5	8
2SD386	705	TO220	2010A	TV Vertical Output	200	120	6	3.0	25*	150	180	1.0m	2	0.5	40~320	5	0.5	8
2SD387	705	TO220	2012	TV Vertical Output	200	120	6	3.0	25*	150	180	1.0m	2	0.5	40~320	5	0.5	8
2SD823	739	TO220	2010A	B/W TV Hori, Output	200	90	7	6.0	40*	150	40	0.1m	5	3.0	>20	5	1.0	15
2SD1159	797	TO220	2010A	TV Hori, Def. Output, High-Power Switching	200	60	6	4.5	40*	150	40	0.1m	5	1.0	30~160	5	1.0	10
2SC3189	452	TO220	2010A	CRT Display Hori. Def. Output (With Damper Diode)	250	100	7	7.0	50*	150	200	0.1m	5	5.0	>12	5	1.0	40
2SC3173	438	TO220	2010A	CRT Display Hori. Def. Output	330	150	6	7.0	50*	150	200	0.1m	1	1.0	>15	10	0.5	40
2SC3174	440	TO220	2010A	CRT Display Hori. Def. Output' (With Damper Diode)	300	150	6	7.0	50*	150	200	0.1m	1	1.0	>15	10	0.5	40
2SC3175	442	TO220	2010A	CRT Display Hori. Def. Output	400	200	6	7.0	50*	150	200	0.1m	1	1.0	>15	10	0.5	40
2SC3176	444	TO220	2010A	CRT Display Hori. Def. Output (With Damper Diode)	400	200	6	7.0	50*	150	200	0.1m	1	1.0	>15	10	0.5	40
2SC3589	614	TO220	2010A	High-Definition Display, Hori. Def. Output	250	100	6	7.0	40	150	150	0.1m	1	1.0	>30	5	1.0	10
2SC3590	617	TO220	2010A	High-Definition Display, Hori. Def. Output	330	150	6	7.0	50	150	180	0.1m	1	1.0	>15	10	0.5	40
2SC3591	619	TO220	2010A	High-Definition Display, Hori. Def. Output	400	220	6	7.0	50	150	250	0.1m	1	1.0	>15	10	0.5	40

TV/CRT DISPLAY APPLICATIONS(II)

(Classified by package and arranged in order of increasing Pc. Minus sign for PNP is omitted due to space limitations.)

Type Number	Page	Case		Applications	Absolute Maximum Ratings/Ta=25°C						Electrical Characteristics/Ta=25°C						
		VCE0	VCE0		VEB0	IC	PC *Tc=25°C	Tj	VCE(sat)			hFE		tf			
									IC	IB	max	VCE	IC	max			
		Package	Package No.		[V]	[V]	[V]	[A]	[W]	[°C]	[A]	[A]	[V]	[V]	[A]	[μs]	
2SC3479	571	TO3PB	2022	High-Definition Display, Hori.Def. Output (With Damper Diode)	1500	800	7	2.5	80*	150	2.0	0.6	8	5	0.5	>8	0.3
2SC3480	574	TO3PB	2022	High-Definition Display, Hori.Def. Output (With Damper Diode)	1500	800	7	3.5	80*	150	2.5	0.8	8	5	0.5	>8	0.3
2SC3483	583	TO3PB	2022	High-Definition Display, Hori.Def. Output	1500	800	7	2.5	80*	150	2.0	0.6	8	5	0.5	>8	0.3
2SC3484	586	TO3PB	2022	High-Definition Display, Hori.Def. Output	1500	800	7	3.5	80*	150	2.5	0.8	8	5	0.5	>8	0.3
2SD1396	867	TO3PB	2022	Hori. Def. Output (With Damper Diode)	1500	800	7	2.5	80*	150	2.0	0.6	8	5	1.0	>8	0.4
2SD1397	870	TO3PB	2022	Hori. Def. Output (With Damper Diode)	1500	800	7	3.5	80*	150	2.5	0.8	8	5	1.0	>8	0.4
2SD1400	879	TO3PB	2022	Hori. Def. Output	1500	800	6	2.5	80*	150	2.0	0.6	8	5	1.0	>8	0.4
2SD1401	882	TO3PB	2022	Hori. Def. Output	1500	800	6	3.5	80*	150	2.5	0.8	8	5	1.0	>8	0.4
2SC3481	577	TO3PB	2022	High-Definition Display, Hori.Def. Output (With Damper Diode)	1500	800	7	5.0	120*	150	4.0	1.0	5	5	1.0	>8	0.3
2SC3482	580	TO3PB	2022	High-Definition Display, Hori.Def. Output (With Damper Diode)	1500	800	7	6.0	120*	150	5.0	1.2	5	5	1.0	>8	0.3
2SC3485	589	TO3PB	2022	High-Definition Display, Hori.Def. Output	1500	800	7	5.0	120*	150	4.0	1.0	5	5	1.0	>8	0.3
2SC3486	592	TO3PB	2022	High-Definition Display, Hori.Def. Output	1500	800	7	6.0	120*	150	5.0	1.2	5	5	1.0	>8	0.3
2SD1398	873	TO3PB	2022	Hori. Def. Output (With Damper Diode)	1500	800	7	5.0	120*	150	4.0	0.8	5	5	1.0	>8	0.4
2SD1399	876	TO3PB	2022	Hori. Def. Output (With Damper Diode)	1500	800	7	6.0	120*	150	5.0	1.0	5	5	1.0	>8	0.4
2SD1402	885	TO3PB	2022	Hori. Def. Output	1500	800	6	5.0	120*	150	4.0	0.8	5	5	1.0	>8	0.4
2SD1403	888	TO3PB	2022	Hori. Def. Output	1500	800	6	6.0	120*	150	5.0	1.0	5	5	1.0	>8	0.4
2SD1649	916	TO3PML	2039	Color TV Hor. Def. Output	1500	800	6	2.5	50*	150	2.0	0.6	8	5	0.5	>8	0.4
2SD1650	919	TO3PML	2039	Color TV Hor. Def. Output	1500	800	6	3.5	50*	150	2.5	0.8	8	5	0.5	>8	0.4
2SD1653	928	TO3PML	2039	Color TV Hor. Def. Output	1500	800	6	2.5	50*	150	2.0	0.6	8	5	0.5	>8	0.4
2SD1654	931	TO3PML	2039	Color TV Hor. Def. Output	1500	800	6	3.5	50*	150	2.5	0.8	8	5	0.5	>8	0.4
2SD1651	922	TO3PML	2039	Color TV Hor. Def. Output	1500	800	6	5	60*	150	4.0	0.8	5	5	1.0	>8	0.4
2SD1652	925	TO3PML	2039	Color TV Hor. Def. Output	1500	800	6	6	60*	150	5.0	1.0	5	5	1.0	>8	0.4
2SD1655	934	TO3PML	2039	Color TV Hor. Def. Output	1500	800	6	5	60*	150	4.0	0.8	5	5	1.0	>8	0.4
2SD1656	937	TO3PML	2039	Color TV Hor. Def. Output	1500	800	6	6	60*	150	5.0	1.0	5	5	1.0	>8	0.4

VERY HIGH-DEFINITION DISPLAY HORIZONTAL OUTPUT, VIDEO OUTPUT APPLICATIONS

(Classified by use and arranged in order of increasing P_C. Minus sign for PNP is omitted due to space limitations.)

● HORIZONTAL DEFLECTION OUTPUT FOR MONOCHROMATIC USE (ADOPTION OF MBIT PROCESS)

Type Number	Page	Case		Applications	Absolute Maximum Ratings/Ta=25°C				Electrical Characteristics/Ta=25°C						
		Package	Package No.		VCB0	VCE0	IC	PC *Tc=25°C	VCE(sat)			hFE		tf	
									IC	IB	max	VCE	IC	max	
															[A]
2SC3636	646	TO3PB	2022	Very High-Definition Display Hor. Def. Output	900	500	7	80	4	0.8	2	5	0.8	>8	0.2
2SC3637	649	TO3PB	2022	Very High-Definition Display Hor. Def. Output	900	500	10	90	5	1.0	2	5	1.0	>8	0.2
2SC3638	652	TO3PB	2022	Very High-Definition Display Hor. Def. Output	900	500	15	100	7	1.4	2	5	1.4	>8	0.2
2SC3642	655	TO3PB	2022	Very High-Definition Display Hor. Def. Output	1200	800	6	100	4	0.8	5	5	0.8	>8	0.2
2SC3643	658	TO3PB	2022	Very High-Definition Display Hor. Def. Output	1200	800	8	120	6	1.2	5	5	1.2	>8	0.2
2SC3644	661	TO3PB	2022	Very High-Definition Display Hor. Def. Output	1200	800	12	150	8	1.6	5	5	1.6	>8	0.2

● HORIZONTAL DEFLECTION OUTPUT FOR COLOR USE (ADOPTION OF MBIT PROCESS)

Type Number	Page	Case		Applications	Absolute Maximum Ratings/Ta=25°C				Electrical Characteristics/Ta=25°C						
		Package	Package No.		VCBO	VCE0	IC	PC *TC=25°C	VCE(sat)			hFE		tf	
									IC	IB	max	VCE	IC		max
*2SC3685	—	TO3PB	2022	Very High-Definition Display Hor. Def. Output	1500	800	6	120	4	1.0	5	5	1	>8	0.2
*2SC3686	—	TO3PB	2022	Very High-Definition Display Hor. Def. Output	1500	800	7	120	5	1.2	5	5	1	>8	0.2
*2SC3687	—	TO3PB	2022	Very High-Definition Display Hor. Def. Output	1500	800	8	150	6	1.5	5	5	1	>8	0.2
*2SC3688	—	TO3PB	2022	Very High-Definition Display Hor. Def. Output	1500	800	10	150	8	2.0	5	5	1	>8	0.2

● VIDEO OUTPUT (ADOPTION OF FBET PROCESS)

Type Number	Page	Case		Applications	Absolute Maximum Ratings/Ta=25°C						Electrical Characteristics/Ta=25°C							
		Package	Package No.		VCB0	VCE0	VEB0	IC	PC *TC=25°C	TJ	ICB0		hFE			fT		
											VCB	(max)	VCE	IC		VCE	IC	
2SC3595	621	TO126	2009	Very High-Definition CRT Display, Video Output	30	20	3	500m	5*	150	20	0.1μ	5	50m	40~200	5	100m	2.0GHz
2SA1406	160	TO126	2009	Very High-Definition CRT Display, Video Output	200	200	4	100m	7*	150	150	0.1μ	10	10m	40~320	30	30m	400
2SC3600	640	TO126	2009	Very High-Definition CRT Display, Video Output	200	200	4	100m	7*	150	150	0.1μ	10	10m	40~320	30	30m	400
2SA1407	162	TO126	2009	Very High-Definition CRT Display, Video Output	200	200	4	150m	7*	150	150	0.1μ	10	10m	40~320	30	50m	400
2SC3601	644	TO126	2009	Very High-Definition CRT Display, Video Output	200	200	4	150m	7*	150	150	0.1μ	10	10m	40~320	30	50m	400
2SA1402	152	TO126	2009	Very High-Definition CRT Display, Video Output	80	60	4	300m	8*	150	60	0.1μ	10	50m	40~320	10	100m	700
2SC3596	624	TO126	2009	Very High-Definition CRT Display, Video Output	80	60	4	300m	8*	150	60	0.1μ	10	50m	40~320	10	100m	700
2SA1404	156	TO126	2009	Very High-Definition CRT Display, Video Output	120	120	4	200m	8*	150	80	0.1μ	10	10m	40~320	10	50m	500
2SC3598	632	TO126	2009	Very High-Definition CRT Display, Video Output	120	120	4	200m	8*	150	80	0.1μ	10	10m	40~320	10	50m	500

2SA1405	158	TO126	2009	Very High-Definition CRT Display, Video Output	120	120	4	300m	8*	150	80	0.1μ	10	50m	40~320	10	50m	500
2SC3599	636	TO126	2009	Very High-Definition CRT Display, Video Output	120	120	4	300m	8*	150	80	0.1μ	10	50m	40~320	10	50m	500
2SA1403	154	TO126	2009	Very High-Definition CRT Display, Video Output	80	60	4	500m	10*	150	60	0.1μ	10	50m	40~320	10	100m	800
2SC3597	628	TO126	2009	Very High-Definition CRT Display, Video Output	80	60	4	500m	10*	150	60	0.1μ	10	50m	40~320	10	100m	800

DYNAMIC FOCUS APPLICATIONS

Type Number	Page	Case		Applications	Absolute Maximum Ratings/Ta=25°C				Electrical Characteristics/Ta=25°C				
		VCBO	VCEO		IC	PC *TC=25°C	hFE			cob			
							VCE	IC	min	VCB	cob		
		Package	Package No.		[V]	[V]	[A]	[W]	[V]	[mA]		[V]	[pF]
2SC3675	684	TO220	2010A	Display, Dynamic Focus	1500	900	0.1	10	5	10	30	100	2.8
2SC3676	687	TO220	2010A	Display, Dynamic Focus	1500	900	0.3	20	5	30	30	100	5.0

LIST OF DISCONTINUED SEMICONDUCTOR PRODUCTS

Note: In this list no distinction is made between PNP and NPN.

Ⓢ: Industrial use

S: Silicon
G: Germanium
AL: Alloy junction type
D: Drift type
DB: Diffused base type
EPL: Epitaxial planar type
ME: Mesa type

EME: Epitaxial mesa type
TME: Triple diffused mesa type
TD: Triple diffused type
TDP: Triple diffused planar type
PL: Planar type
J: Junction type
DJ: Diffused junction type
PC: Point contact type

↑: $T_c = 25^\circ\text{C}$

! : Specified case temperature

⊥ : With specified heat sink

Type Number	Discontinued Package	Applications	Replacement	Case Outline	Structure	Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$						Electrical Characteristics/ $T_a=25^{\circ}\text{C}$												Remarks	
						V_{CB0}	V_{CE0} $\uparrow V_{CER}$	V_{EBO}	I_c	P_c	T_j (max)	V_{CB}	I_{CB0} max	V_{EB}	I_{EBO} max	V_{CE}	I_c	f	h_{FE} $\uparrow h_{fe}$	V_{CB}	I_c	f_T $\uparrow f_{ab}$	V_{CB}		$\uparrow c_{ob}$ c_{re}
Units shown right are omitted on and after next page.						V	$V_{(R_{BE}:\Omega)}$	V	A	W	$^{\circ}\text{C}$	V	A	V	A	V	A	Hz	—	V	A	MHz	V	pF	
2SA182 ⑤		Medium Speed Switching, HF Amp	—	G,AL	25	12	12	100m	100m	85	15	5 μ	12	10 μ	1.5	30m	—	30~150	6	1 m	$\uparrow$ 8	6	11		
2SA198		AM IF Amp	—	G,AL	15	—	2	5m	30m	85	15	25 μ	2	15 μ	6	1 m	455 k	$\uparrow$ 25	—	—	—	6	12		
2SA201		AM Converter, MIX, IF Amp	—	G,AL	15	—	10	15m	100m	85	15	10 μ	2	7 μ	6	1 m	455 k	$\uparrow$ 9~16	—	—	—	6	<14.5		
2SA202		AM IF Amp	—	G,AL	15	—	10	15m	100m	85	15	10 μ	2	7 μ	6	1 m	455 k	$\uparrow$ 11~27.5	—	—	—	6	<12.5		
2SA203		AM IF Amp	—	G,AL	15	—	10	15m	100m	85	15	10 μ	2	7 μ	6	1 m	455 k	$\uparrow$ 4~16	—	—	—	6	<12.5		
2SA219		TV Sound IF, FM IF Amp	—	G,D	20	—	1.5	15m	70m	85	15	15 μ	1.5	40 μ	6	1 m	1 k	$\uparrow$ 27~330	6	1 m	$\uparrow$ 55	6	3.5		
2SA220		AM RF Amp	—	G,D	20	—	0.5	10m	50m	85	15	15 μ	0.5	15 μ	6	1 m	1 k	$\uparrow$ 150	6	1 m	$\uparrow$ 60	6	3.5		
2SA221		SW Converter, OSC, MIX	—	G,D	20	—	1.5	15m	70m	85	15	15 μ	1.5	40 μ	6	1 m	1 k	$\uparrow$ 27~330	—	—	—	6	3.5		
2SA222		SW Converter	—	G,D	20	—	1.5	15m	70m	85	15	15 μ	1.5	40 μ	6	1 m	1 k	$\uparrow$ 27~330	—	—	—	6	3.5		
2SA223		SW OSC, MIX	—	G,D	20	—	1.5	15m	70m	85	15	15 μ	1.5	40 μ	6	1 m	1 k	$\uparrow$ 27~330	—	—	—	6	3.5		
2SA227		AM RF Amp	—	G,D	20	—	0.5	10m	50m	85	6	12 μ	0.5	15 μ	6	1 m	1 k	$\uparrow$ 70	6	1 m	$\uparrow$ 95	6	3.0		
2SA263		TV MIX, OSC	—	G,ME	20	—	0.4	5m	50m	85	15	10 μ	0.5	50 μ	6	2 m	100M	$\uparrow$ 4	6	2 m	500	6	1.5		
2SA264		TV RF Amp	—	G,ME	20	—	0.4	5m	50m	85	15	10 μ	0.5	50 μ	6	2 m	100M	$\uparrow$ 6	6	2 m	500	6	1.5		
2SA265		TV MIX, Local OSC	—	G,ME	20	—	0.4	5m	50m	85	15	10 μ	0.5	50 μ	6	2 m	100M	$\uparrow$ 6	6	2 m	500	6	1.5		
2SA321		FM IF Amp	—	G,D	20	—	1.5	15m	70m	85	15	15 μ	1.5	40 μ	6	1 m	1 k	$\uparrow$ 27~330	6	1 m	$\uparrow$ 25	6	<4.5		

Type Number	Discontinued Package	Applications	Replacement	Case Outline	Structure	Absolute Maximum Ratings/Ta=25°C						Electrical Characteristics/Ta=25°C														Remarks
						V _{CE0}	V _{CE0} † V _{CER}	V _{EB0}	I _c	P _c	T _j (max)	V _{CE}	I _{CE0} max	V _{EB}	I _{EB0} max	V _{CE}	I _c	f	h _{FE} † f _{hfe}	V _{CE}	I _c	f _T	V _{CE}	I _c	c _{ob} † c _{re}	
2SA322		SW RF, IF		—	G, D	20	—	1.5	15m	70m	85	15	15μ	1.5	40μ	6	1m	1k	†27~330	6	1m	†35	6	<5.0		
2SA323		AM Converter		—	G, D	20	—	0.5	15m	70m	85	15	15μ	0.5	15μ	6	1m	1k	† 80	6	1m	†40	6	<5.5		
2SA324		FM IF Amp		—	G, D	20	—	1.5	15m	70m	85	15	15μ	1.5	40μ	6	1m	1k	† 80	6	1m	†55	6	<6.0		
2SA329		AM Converter, IF Amp		—	G, D	15	—	1.0	10m	50m	85	10	15μ	1.0	70μ	6	1m	1k	†13~385	—	—	—	6	<6.5		
2SA330		AM Converter, IF Amp		—	G, D	20	—	1.5	10m	50m	85	12	15μ	1.5	60μ	6	1m	1k	†13~550	—	—	—	6	<6.5		
2SA331		27MHz Transceiver Output		—	G, D	40	—	1.5	50m	150m	85	15	15μ	1.5	40μ	6	1m	1k	†27~330	6	1m	†>40	6	<5.0		
2SA420		VHF, RF Amp, MIX		—	G, ME	20	—	0.3	5m	50m	85	12	10μ	0.3	50μ	12	2m	1k	† 25	12	2m	†550	6	2.0		
2SA421		UHF Converter, OSC		—	G, ME	20	—	0.3	5m	50m	85	12	10μ	0.3	50μ	12	2m	1k	† 25	12	2m	680	12	1.0		
2SA422		UHF, RF Amp, MIX, OSC		—	G, ME	20	—	0.4	5m	50m	85	20	30μ	0.4	100μ	12	2m	1k	† 25	12	2m	800	6	0.8		
2SA440A		VHF, RF Amp, MIX, OSC		—	G, ME	20	—	0.4	5m	60m	85	20	30μ	0.4	50μ	6	2m	1k	† 50	6	2m	350	6	1.5		
2SA532		LF Amp	2SB560	—	S,TDP	50	40	5	200m	500m	150	40	10μ	3	10μ	6	50m	—	40~320	6	10m	90	—	—		
2SA532Ⓢ		LF Amp		—	S,TDP	50	50	5	200m	500m	150	40	0.1μ	4	0.1μ	6	50m	—	40~320	6	10m	90	6	5		
2SA551		LF Amp		—	S,EPL	70	70	5	400m	600m	150	70	10μ	5	10μ	4	0.2	—	40~200	4	10m	80	—	—		
2SA608	RE3	General-purpose Amp, Switching	2SA608 (SP,NP)	—	S,EPL	40	30	5	100m	100m	125	25	1μ	4	1μ	6	1m	—	60~560	6	10m	180	6	7		
2SA608Ⓢ	RE3	HF Amp, HF Switching		—	S,EPL	40	30	5	100m	100m	125	25	1μ	4	1μ	6	1m	—	60~560	6	10m	180	6	7		
2SA609	RE3	General-purpose Amp, Switching	2SA608 (SP,NP)	—	S,EPL	30	15	5	100m	100m	125	25	1μ	4	1μ	6	1m	—	60~560	6	1m	80	6	7		
2SA609Ⓢ	RE3	General-purpose Switching		—	S,EPL	30	15	5	100m	100m	125	25	0.1μ	4	0.1μ	6	1m	—	60~560	6	1m	80	6	12		
2SA659	FP	LF Small Signal Amp		—	S,TDP	50	50	5	200m	400m	125	40	10μ	3	10μ	6	50m	—	40~320	6	10m	90	—	—		
2SA659Ⓢ	FP	LF Amp		—	S,TDP	50	50	5	200m	300m	125	40	0.1μ	4	0.1μ	6	50m	—	40~320	6	10m	90	—	—		
2SA659	NP	LF Small Signal Amp	2SA984	2003A	S,TDP	50	50	5	200m	400m	125	40	10μ	3	10μ	6	50m	—	40~320	6	10m	90	—	—		
2SA701	RE3	Very Low Noise, Small Signal Amp		—	S,EPL	30	30	5	50m	100m	125	25	1μ	4	1μ	6	1m	—	100~560	6	1m	80	—	—		
2SA701	NP	Very Low Noise, Small Signal Amp		2003	S,EPL	30	30	5	50m	200m	125	25	1μ	4	1μ	6	1m	—	100~560	6	1m	80	—	—		
2SA702	RE3	Very Low Noise, Small Signal Amp		—	S,EPL	50	50	5	50m	100m	125	45	1μ	4	1μ	6	1m	—	100~560	6	1m	80	—	—		
2SA702	NP	Very Low Noise, Small Signal Amp		2003	S,EPL	50	50	5	50m	200m	125	45	1μ	4	1μ	6	1m	—	100~560	6	1m	80	—	—		
2SA714		LF High Power Amp		2016	S,TME	150	100	6	7	†60	150	30	1m	6	5m	5	1	—	40~320	5	1	8	—	—		
2SA714L		LF High Power Amp		2016	S,TME	100	80	6	7	†60	150	30	1m	6	5m	5	1	—	40~320	5	1	8	—	—		
2SA1017		LF Power Amp	2SA1207	2003A	S,EPL	120	100	5	50m	500m	125	80	1μ	4	1μ	6	1m	—	100~560	6	1m	110	10	2.2		

Type Number	Discontinued Package	Applications	Replacement	Case Outline	Structure	Absolute Maximum Ratings/Ta=25°C						Electrical Characteristics/Ta=25°C														Remarks				
						V _{CB0}	V _{CEO} † V _{CER}	V _{EB0}	I _c	P _c	T _j (max)	V _{CB}	I _{CBO} max		V _{EB}	I _{EB0} max		V _{CE}	I _c	f	h _{FE} † h _{fe}		V _{CB} V _{CE}	I _c	f _T † f _{gb}		V _{CB}	c _{ob} † c _{re}		
2SA1019		LF Power Amp	2SA1208	2006	S,EPL	150	120	5	50m	900m	150	80	1 μ	4	1 μ	6	1 m	—	100~560	6	1 m	116	10	2.2	} : With R1A fin					
2SA1047		LF Power Amp	2SA1209	2009	S,EPL	180	160	5	80m	1	150	120	1 μ	4	1 μ	5	10m	—	60~320	10	10m	130	10	3.2						
2SB22		LF Power Amp	—	—	G, AL	25	—	12	200m	±300m	85	20	15 μ	6	12 μ	1.5	100m	—	67~330	—	—	—	—	—						
2SB22 ⑤		Low Speed Switching, AF Amp	—	—	G, AL	50	25	12	200m	±300m	85	40	15 μ	6	15 μ	1.5	100m	—	100	6	1 m	† 1	—	—						
2SB185		LF Power Amp	—	—	G, AL	25	—	12	150m	200m	85	20	15 μ	6	12 μ	6	1 m	1 k	† 45	6	1 m	† 1	—	—						
2SB186		LF Power Amp	—	—	G, AL	25	—	12	150m	200m	85	20	15 μ	6	12 μ	6	1 m	1 k	† 120	6	1 m	† 1	—	—	} : With specified fin					
2SB187		LF Power Amp	—	—	G, AL	25	—	12	150m	200m	85	20	15 μ	6	12 μ	1.5	30m	—	50~220	6	1 m	† 1	—	—						
2SB187⑤		Low Speed Switching, AF Amp	—	—	G, AL	50	25	12	150m	200m	85	30	10 μ	6	10 μ	1.5	30m	—	50~165	6	1 m	† 1	—	—						
2SB188		LF Small Signal Amp	—	—	G, AL	25	—	12	150m	200m	85	20	15 μ	6	12 μ	6	1 m	1 k	† 20	6	1 m	† 1	—	—						
2SB215		LF Power Amp	—	—	G, AL	100	—	20	3	† 20	85	20	500 μ	10	500 μ	1.5	1.0	—	100	1.5	0.2	† 0.5	—	—						
2SB216		LF Power Amp	—	—	G, AL	60	—	10	1.5	† 20	85	20	500 μ	10	500 μ	1.5	1.0	—	70	1.5	0.2	† 0.5	—	—	} : With specified fin					
2SB216A		LF Power Amp	—	—	G, AL	90	—	10	1.5	† 20	85	20	500 μ	10	500 μ	1.5	1.0	—	70	1.5	0.2	† 0.5	—	—						
2SB217		LF Power Amp	—	—	G, AL	20	—	10	1.5	† 20	85	20	500 μ	10	500 μ	1.5	1.0	—	70	1.5	0.2	† 0.5	—	—						
2SB254		LF Power Amp	—	—	G, AL	35	—	12	1.0	±3.3	85	25	200 μ	12	200 μ	1.5	0.2	—	100	1.5	0.2	† 0.4	—	—						
2SB255		LF Power Amp	—	—	G, AL	35	—	12	1.0	±3.3	85	25	200 μ	12	200 μ	1.5	0.2	—	50	1.5	0.2	† 0.4	—	—						
2SB256		LF Power Amp	—	—	G, AL	25	—	12	1.0	±3.3	85	25	200 μ	12	200 μ	1.5	0.2	—	75	1.5	0.2	† 0.4	—	—	} : With specified fin					
2SB270		LF Small Signal Amp	—	—	G, AL	12	—	5	50m	150m	85	6	15 μ	0.5	10 μ	6	1 m	1 k	† 80	6	1 m	† 1.0	—	—						
2SB272		LF Output Amp	—	—	G, AL	25	—	10	0.5	† 0.72	85	12	60 μ	6	30 μ	1.5	0.1	—	200	1.5	0.1	† 0.5	—	—						
2SB273		LF Output Amp	—	—	G, AL	35	—	10	0.5	† 0.72	85	12	60 μ	6	30 μ	1.5	0.1	—	150	1.5	0.1	† 0.5	—	—						
2SB303		Low Noise Amp	—	—	G, AL	25	—	12	20m	100m	85	15	15 μ	6	12 μ	6	1 m	1 k	† 22~396	6	1 m	† 1	6	28						
2SB342		TV Hori. Def. Driver	—	—	G, DB	120	—	1	6	† 30	85	120	5 m	1	5 m	1.5	5	—	50	1.5	0.5	† 1.5	—	—	} : With specified fin					
2SB343		TV Ver. Def. Output	—	—	G, DB	150	—	1	6	† 30	85	150	5 m	1	5 m	1.5	5	—	50	1.5	0.5	† 1.5	—	—						
2SB372		LF Power Amp	—	—	G, AL	25	—	10	10	† 1.5	85	20	50 μ	10	50 μ	1.5	0.2	—	150	1.5	0.2	† 0.7	—	—						
2SB373		LF Output Amp	—	—	G, AL	25	—	10	10	† 1.5	85	20	50 μ	10	50 μ	1.5	0.2	—	150	1.5	0.2	† 0.7	—	—						
2SB375A		TV Hori. Output	—	—	G, DB	150	† 150 (50Ω)	3	9	† 30	85	150	5 m	3	90 m	1.5	4	—	30~125	1.5	0.5	>1.3	—	—						
2SB390		LF Power Amp	—	—	G, DB	80	—	1	6	† 30	85	15	200 μ	1	5 m	1.5	3	—	50	1.5	0.5	† 1.5	—	—	} : With specified fin					
2SB391		LF Power Amp	—	—	G, DB	50	—	1	6	† 30	85	15	200 μ	1	5 m	1.5	3	—	75	1.5	0.5	† 1.5	—	—						

Type Number	Discontinued Package	Applications	Replacement	Case Outline	Structure	Absolute Maximum Ratings/Ta=25°C						Electrical Characteristics/Ta=25°C													Remarks
						V _{CB0}	V _{CE0} † V _{CEr}	V _{EB0}	I _c	P _c	T _j (max)	V _{CB}	I _{CB0} max	V _{EB}	I _{EB0} max	V _{CE}	I _c	f	h _{FE} † h _{FEr}	V _{CB} V _{CE}	I _c	f _T † f _g	V _{CB}	c _{cb} † c _{re}	
2SB400		LF Low Noise Amp		—	G, AL	20	—	10	40m	100m	85	15	15μ	6	12μ	6	1m	1k	†54~396	6	1m	†1	6	28	
2SB400S		LF Low Noise Amp		—	G, AL	20	20	10	40m	100m	85	15	15μ	6	10μ	6	1m	1k	†120	—	—	—	—	—	
2SB405		LF Power Amp		—	G, AL	25	†25 (100Ω)	6	1	†0.72	85	20	25μ	4	25μ	1	0.2	—	50~275	1	0.2	†0.7	—	—	
2SB405ST		Strobe, DC Converter		—	G, AL	40	†25 (100Ω)	12	1	†0.72	85	20	25μ	10	50μ	2	2	—	70~300	1	0.1	1.5	—	—	
2SB405S		Low Speed Switching, Power Amp		—	G, AL	50	25	12	1	†0.72	85	30	25μ	6	20μ	1	0.2	—	100	1	0.2	†0.75	—	—	
2SB407		LF Power Amp		—	G, AL	30	†30 (300Ω)	10	7	†30	85	30	500μ	10	500μ	1.5	1.0	—	27~275	1.5	0.5	0.35	—	—	
2SB407S		LF Power Amp		—	G, AL	60	30	10	10	†30	85	30	100μ	10	500μ	1.5	1.0	—	80	1.5	0.5	0.35	—	—	
2SB408		TV Hori. OSC		—	G, AL	25	—	12	0.2	±0.3	85	20	15μ	6	15μ	1.5	0.1	—	175	—	—	—	—	—	With R1A fin
2SB410		TV Def. Output, Power Amp		—	G, DB	135	†135 (50Ω)	5	15	†40	85	30	250μ	1	5m	1.5	8	—	50	1.5	0.5	3	—	—	
2SB410AF		LF High Power Amp		—	G, DB	55	†55 (50Ω)	1	15	†40	85	30	250μ	1	5m	1.5	1	—	27~275	1.5	0.5	3	—	—	
2SB410S		Power Switching, Power Amp		—	G, DB	80	80	5	15	†40	85	50	500μ	1	5m	1.5	4	—	30~100	1.5	0.5	3	—	—	
2SB411		TV Hori. Def. Output, Power Amp		—	G, DB	200	†200 (50Ω)	5	11	†40	85	30	250μ	1	5m	1.5	8	—	40	1.5	0.5	2.5	—	—	
2SB411AF		LF High Power Amp		—	G, DB	200	†55 (50Ω)	1	11	†40	85	30	250μ	1	5m	1.5	1	—	27~275	1.5	0.5	2.5	—	—	
2SB411S		Power Switching, Power Amp		—	G, DB	200	120	5	11	†40	85	50	500μ	1	5m	1.5	4	—	30~100	1.5	0.5	2.5	—	—	
2SB412		Low Speed Switching		—	G, DB	300	—	5	11	†40	85	30	250μ	1	5m	1.5	8	—	50	—	—	—	—	—	
2SB474		LF Power Amp		—	G, AL	35	†35 (100Ω)	6	2	†12	85	25	200μ	6	200μ	1.5	0.2	—	50~275	1.5	0.2	†0.7	—	—	
2SB474S		LF Power Amp		—	G, AL	60	30	12	2	†12	85	30	50μ	6	200μ	1.5	0.2	—	50~140	—	—	—	—	—	
2SB492		LF Power Amp		—	G, AL	25	†25 (100Ω)	6	2	†6	85	20	50μ	6	80μ	1.5	0.2	—	50~275	1.5	0.2	†0.7	—	—	
2SB492ST		Strobe, DC Converter		—	G, AL	50	†35 (100Ω)	12	2	†6	85	25	100μ	10	100μ	2	3	—	70~300	1.0	0.1	1.5	—	—	
2SB492S		LF Power Amp		—	G, AL	50	25	12	2	†6	85	30	50μ	6	20μ	1.5	0.2	—	80	1.5	0.2	†0.7	—	—	
2SB507	Old TO220	LF High Power Amp	2SB507 (TO220AB)	—	S,TDP	60	60	5	3	†30	150	20	0.1m	4	1.0m	2	1	—	40~320	5	0.5	8	10	130	
2SB508	Old TO220	LF High Power Amp	2SB508 (TO220AA)	—	S,TDP	60	60	5	3	†30	150	20	0.1m	4	1.0m	2	1	—	40~320	5	0.5	8	10	130	
2SB509		LF High Power Amp	—	—	S, ME	60	60	5	4	†35	150	20	0.1m	4	1.0m	2	1	—	40~320	5	0.5	8	—	—	
2SB511	Old TO220	LF Power Amp	2SB511 (TO220AB)	—	S,TDP	35	35	5	1.5	†10	150	20	0.1m	4	1.0m	2	1	—	40~320	5	0.5	8	—	—	
2SB514	Old TO220	LF High Power Amp	2SB514 (TO220AB)	—	S,TDP	50	50	5	2	†20	150	20	0.1m	4	1.0m	2	1	—	40~320	5	0.5	8	—	—	
2SB515	Old TO220	LF High Power Amp	2SB515 (TO220AA)	—	S,TDP	50	50	5	2	†20	150	20	0.1m	4	1.0m	2	1	—	40~320	5	0.5	8	—	—	
2SB544	Larger FP	Cassette Tape Recorder Power Amp, Electronic Governor, Driver	2SB544 (MP)	—	S,EPL	25	25	5	1	0.75	125	20	1.0μ	4	1.0μ	2	50m	—	60~320	10	50m	180	10	25	

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						V _{CBO}	V _{CEO} † V _{CER}	V _{EBO}	I _c	P _c	T _j (max)	V _{CB}	I _{CBO} max	V _{EB}	I _{EBO} max	V _{CE}	I _c	f	h _{FE} † h _{fe}	V _{CB} V _{CE}	I _c	f _T † f _{ab}	V _{CB}	c _{ob} † c _{re}		
2SB544(P1)	Larger FP	Cassette Tape Recorder Power Amp, Electronic Governor, Driver	2SB544 (MP)	—	S,EPL	25	25	5	1	1	125	20	1.0μ	4	1.0μ	2	50m	—	60~320	10	50m	180	10	25		
2SB544(P2)	Larger FP		2SB544 (MP)	—	S,EPL	25	25	5	1	1	125	20	1.0μ	4	1.0μ	2	50m	—	60~320	10	50m	180	10	25		
2SB559	Larger FP	LF Power Amp, Medium Speed Switching	2SB559 (TO18)	2006	S,EPL	60	50	5	0.7	0.75	125	20	1.0μ	4	1.0μ	5	50m	—	60~320	10	50m	100	10	15		
2SB560	FP	Audio Driver, General-purpose Amp	2SB560 (MP)	—	S,EPL	100	80	5	0.7	0.75	125	20	1.0μ	4	1.0μ	5	50m	—	60~320	10	50m	100	10	15		
2SB598	FP	Electronic Governor DC-DC Converter, 1W Sound Output	2SB598 (NP)	—	S,EPL	25	25	5	1	600m	125	20	1.0μ	4	1.0μ	2	50m	—	60~320	10	50m	180	10	25		
2SB633P		LF Power Amp, 25 to 35W Output	—	—	S,EPL	100	85	6	6	†50	150	40	0.1m	4	0.1m	5	1	—	40~320	5	1	15	10	150		
2SB634		LF Power Amp	—	2016	S,EME	120	100	6	7	†60	150	80	0.1m	4	0.1m	5	1	—	40~320	5	1	15	—	—		
2SB696		LF Power Amp	2SB816	—	S,EME	150	120	6	8	†80	150	80	0.1m	4	0.1m	5	1	—	40~320	5	1	15	—	—		
2SB696K		LF Power Amp	2SB816	—	S,EME	150	140	6	8	†80	150	80	0.1m	4	0.1m	5	1	—	40~320	5	1	15	—	—		
2SB697		LF Power Amp	2SB817	2017	S,EME	160	140	6	12	†100	150	80	0.1m	4	0.1m	5	1	—	40~320	5	1	15	—	—		
2SB697K		LF Power Amp	2SB817	2017	S,EME	180	160	6	12	†100	150	80	0.1m	4	0.1m	5	1	—	40~320	5	1	15	—	—		
2SB823		LF Power Amp, 60W Output	—	2010	S, PL	100	85	6	6	†40	150	40	0.1m	4	0.1m	5	1	—	60~200	5	1	15	10	150		
2SB914		Various Drivers	2SB912	2017	S,EPL	70	60	6	10	†70	150	40	0.1m	5	3m	2	5	—	5000	5	5	20	—	—		
2SB915		Various Drivers	2SB883	2017	S,EPL	70	60	6	15	†80	150	40	0.1m	5	3m	2	7	—	5000	5	7	20	—	—		
2SB916		Various Drivers	2SB913	2017	S,EPL	110	100	6	8	†70	150	80	0.1m	5	3m	3	4	—	4000	5	4	20	—	—		
2SB920		High Current Switching	—	2010A	S,EPL	120	80	6	5	†30	150	80	0.1m	4	0.1m	2	1	—	70~280	5	1	20	—	—		
2SB921		High Current Switching	—	2010A	S,EPL	120	80	6	7	†40	150	80	0.1m	4	0.1m	2	1	—	70~280	5	1	20	—	—		
2SB922		High Current Switching	—	2022	S,EPL	120	80	6	12	†80	150	80	0.1m	4	0.1m	2	1	—	70~280	5	1	20	—	—		
2SB991		Color TV Ver., Sound Output	2SB1037	2013	S,TDP	180	180	6	1.5	†25	150	80	10μ	4	10μ	5	0.3	—	40~200	5	100m	8	—	—		
2SC60		TV Sync Separation	2SC536 (SP,NP)	—	G, AL	80	—	10	20m	100m	85	20	15μ	6	15μ	6	1m	1k	† 50	6	1m	† 5	—	—		
2SC65Y		TV Video Output, HF Amp	2SC1756	—	S, ME	150	†150 (1kΩ)	4	50m	600m	150	150	15μ	4	10μ	20	5m	—	10~200	10	10m	120	10	3.5		
2SC423		HF, LF Amp, Switching	—	—	S,EPL	40	—	5	300m	500m	175	35	1μ	4	1μ	5	20m	—	25~560	10	20m	470	10	5		
2SC423Ⓢ		Switching, Amp	—	—	S,EPL	40	20	4	300m	500m	175	35	0.1μ	3	0.1μ	5	20m	—	40~560	10	20m	470	10	5		
2SC424		General-purpose Amp, Switching	—	—	S,EPL	40	—	5	300m	200m	175	35	1μ	4	1μ	5	20m	—	80	10	20m	500	—	—		
2SC425		General-purpose Amp, Switching	—	—	S,EPL	20	—	5	300m	600m	175	15	1μ	4	1μ	5	20m	—	25~560	10	20m	470	10	5		
2SC426		General-purpose Amp, Switching	—	—	S,EPL	20	—	5	300m	200m	175	15	1μ	4	1μ	5	20m	—	80	10	20m	500	—	—		
2SC536	RE3	Small Signal, General-purpose Amp	2SC536 (SP,NP)	—	S,TDP	40	20	5	100m	200m	125	35	1μ	4	1μ	6	1m	—	40~850	6	1m	150	6	3.0		

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						V _{CB0}	V _{CEO} † V _{CER}	V _{EBO}	I _c	P _c	T _j (max)	V _{CE}	I _{CB0} max	V _{EB}	I _{EBO} max	V _{CE}	I _c	f	h _{FE} † h _{fe}	V _{CE} V _{CE}	I _c	f _r † f _{ab}	V _{CE}	c _{ob} † c _{tr}		
2SC536	FP	Small Signal, General-purpose Amp	2SC536 (SP,NP)	—	S, PL	40	30	5	100m	250m	125	35	1 μ	4	1 μ	6	1m	—	60~960	6	1m	100	6	3.5		
2SC536Ⓢ	RE3	Small Signal, General-purpose Amp		—	S,TDP	40	30	4	100m	125m	125	35	0.1 μ	3	0.1 μ	6	1m	—	40~560	6	1m	150	6	3.0		
2SC536FPⓈ	FP	Small Signal, General-purpose Amp		—	S, PL	40	30	5	100m	200m	125	35	0.1 μ	3	0.1 μ	6	1m	—	60~960	6	1m	100	6	3.5		
2SC537	RE3	Small Signal, General-purpose Amp	2SC536 (SP,NP)	—	S, TDP	20	—	5	100m	200m	125	15	1 μ	4	1 μ	6	1m	—	40~850	6	1m	150	6	3.0		
2SC537	FP	Small Signal, General-purpose Amp	2SC536 (SP,NP)	—	S, PL	20	—	5	100m	200m	125	15	1 μ	4	1 μ	6	1m	—	25~560	6	1m	150	6	4.0		
2SC544		FM/AM HF Amp	2SC930 (SP,NP)	—	S,EPL	40	—	5	30m	125m	125	35	1 μ	4	1 μ	6	1m	—	40~320	6	1m	350	6	1.7		
2SC545		FM/AM HF Amp	2SC930 (SP,NP)	—	S,EPL	20	—	5	30m	125m	125	15	1 μ	4	1 μ	6	1m	—	40~320	6	1m	350	6	1.7		
2SC614		Transceiver Output, General-purpose Amp		—	S,EPL	80	—	4	1.5	†7.5	175	40	1 μ	3	0.5m	10	250m	—	25~560	20	250m	200	20	12.5		
2SC614Ⓢ		General-purpose Amp		—	S,EPL	80	40	4	1.5	†7.5	175	40	0.1 μ	3	10 μ	10	250m	—	40~560	20	250m	200	20	12.5		
2SC615		Transceiver Output, General-purpose Amp		—	S,EPL	30	—	4	1.5	†7.5	175	10	1 μ	3	0.5m	10	250m	—	25~560	20	250m	200	20	12.5		
2SC615Ⓢ		General-purpose Amp		—	S,EPL	30	20	4	1.5	†7.5	175	10	0.1 μ	3	10 μ	10	250m	—	40~560	20	250m	200	20	12.5		
2SC668	RE3	FM RF, Converter		—	S,TDP	15	—	3	30m	120m	125	10	1 μ	3	1 μ	6	1m	—	25~320	6	4m	600	6	†0.75		
2SC674		VHF RF Amp	2SC2999	2000B	S,TDP	25	20	3	30m	150m	125	10	1 μ	3	1 μ	6	1m	—	40~320	6	4m	600	6	†0.75		
2SC674	RE3	VHF RF Amp (Forward AGC)		—	S,TDP	15	—	3	30m	120m	125	10	1 μ	3	1 μ	6	1m	—	25~320	6	4m	600	6	†0.75		
2SC674Ⓢ	RE3	VHF Amp (Forward AGC)		—	S,TDP	30	20	3	30m	120m	125	25	0.1 μ	2	0.1 μ	6	1m	—	60	6	1m	700	6	1.1		
2SC693	RE3	Small Signal, Low Noise Amp	2SC693 (NP)	—	S,TDP	40	—	5	50m	100m	125	35	1 μ	4	1 μ	6	1m	—	100~850	6	1m	150	6	3.0		
2SC693	FP	Small Signal, Low Noise Amp	2SC693 (NP)	—	S, PL	40	30	5	50m	100m	125	35	1 μ	4	1 μ	6	1m	—	160~960	6	1m	100	6	3.5		
2SC693Ⓢ	RE3	Small Signal, Low Noise Amp		—	S,TDP	40	20	5	50m	100m	125	35	0.1 μ	4	0.1 μ	6	1m	—	160~850	6	1m	150	6	3.0		
2SC694	RE3	Low Noise Amp	2SC693 (NP)	—	S,TDP	40	—	5	50m	100m	125	35	1 μ	4	1 μ	6	1m	—	100~560	6	2m	230	6	3.0		
2SC705		UHF OSC		—	S,EPL	15	—	3	30m	120m	125	10	1 μ	3	1 μ	6	1m	—	25~320	6	1m	700	6	†0.95		
2SC706		VHF Amp		—	S,EPL	15	—	3	30m	120m	125	10	1 μ	3	1 μ	6	1m	—	80	6	1m	800	—	—		
2SC715		LF Amp, Transceiver Output	2SC536 (SP,NP)	—	S,EPL	40	—	5	100m	125m	125	35	1 μ	4	1 μ	6	1m	—	25~560	6	2m	200	6	3.0		
2SC715Ⓢ		Switching, HF Amp		—	S,EPL	40	30	4	100m	125m	125	35	0.1 μ	3	0.1 μ	1	10m	—	40~560	6	1m	150	6	3.0		
2SC716		LF Amp, Transceiver Output	2SC536 (SP,NP)	—	S,EPL	20	—	5	100m	125m	125	15	1 μ	4	1 μ	6	1m	—	25~560	6	2m	200	6	3.0		
2SC772		FM HF Amp, IF Amp	2SC930 (SP,NP)	—	S,EPL	15	—	5	30m	120m	125	10	1 μ	4	1 μ	6	1m	—	25~320	6	1m	350	6	†1.0		
2SC772Ⓢ		HF Amp, Switching		—	S,EPL	30	20	4	30m	120m	125	35	0.1 μ	3	0.1 μ	6	1m	—	50	6	1m	350	6	†1.0		
2SC858	RE3	Small Signal, Low Noise Amp	2SC693 (NP)	—	S,TDP	20	—	5	50m	100m	125	15	1 μ	4	1 μ	6	1m	—	100~850	6	1m	150	6	3.0		

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						V _{CB0}	V _{CEO} † V _{CER}	V _{EBO}	I _c	P _c	T _j (max)	V _{CB}	I _{CB0} max	V _{EB}	I _{EBO} max	V _{CE}	I _c	f	h _{FE} † h _{fe}	V _{CB} V _{CE}	I _c	f _T † f _{ab}	V _{CB}	c _{ob} † c _{re}		
2SC858	FP	Small Signal, Low Noise Amp	2SC693 (NP)	—	S, PL	20	—	5	50m	100m	125	15	1μ	4	1μ	6	1m	—	100~850	6	1m	150	6	4.0	: With R1A fin	
2SC859		Low Noise Amp	2SC693 (NP)	—	S, TDP	20	—	5	50m	100m	125	15	1μ	4	1μ	6	1m	—	100~560	6	2m	230	6	3.0		
2SC860		UHF OSC		—	S, EPL	15	—	3	30m	±80m	125	10	1μ	3	1μ	6	1m	—	40~200	6	1m	700	6	†0.7		
2SC875		Low Noise Amp	2SD438	—	S, TDP	75	75	5	200m	500m	150	40	10μ	3	10μ	6	50m	—	40~320	6	10m	170	6	5		
2SC875S		Switching, LF Amp		—	S, TDP	75	75	5	200m	500m	150	40	0.1μ	4	0.1μ	6	50m	—	40~320	6	10m	170	6	5		
2SC876		LF Amp	2SD438	—	S, TDP	50	50	5	200m	500m	150	40	10μ	3	10μ	6	50m	—	40~320	6	10m	170	6	5		
2SC876S		Switching, LF Amp		—	S, TDP	50	50	5	200m	500m	150	40	0.1μ	4	0.1μ	6	50m	—	40~320	6	10m	170	6	5		
2SC927		VHF RF Amp with AGC		—	S, TDP	30	25	3	20m	150m	150	25	1μ	3	1μ	6	1m	—	25~200	6	3m	500	6	†0.45		
2SC928		VHF RF Amp with AGC		—	S, TDP	30	15	3	20m	150m	150	25	1μ	3	1μ	6	1m	—	25~200	6	3m	500	6	†0.45		
2SC928S		VHF RF, IF Amp		—	S, TDP	30	15	3	20m	150m	150	10	0.1μ	2	0.5μ	6	1m	—	25~200	6	3m	500	6	†0.45		
2SC929	RE3	AM Converter, FM RF, IF Amp		—	S, EPL	15	10	5	30m	120m	125	10	1μ	4	1μ	6	1m	—	40~320	6	1m	300	6	†1.1		
2SC929S	RE3	AM Converter, FM RF, IF Amp		—	S, EPL	30	20	4	30m	120m	125	10	0.1μ	3	0.5μ	6	1m	—	25~320	6	1m	300	6	†1.1		
2SC929	SP	AM Converter, FM RF, IF Amp	2SC2839	2000B	S, EPL	30	20	5	30m	250m	125	10	1μ	4	1μ	6	1m	—	40~200	6	1m	300	6	†<1.6		
2SC929	NP	AM Converter, FM RF, IF Amp	2SC2839	2003A	S, EPL	30	20	5	30m	250m	125	10	1μ	4	1μ	6	1m	—	40~200	6	1m	300	6	†1.3		
2SC930	RE3	AM Converter, FM RF, IF Amp	2SC930 (SP, NP)	—	S, EPL	15	10	5	30m	120m	125	10	1μ	4	1μ	6	1m	—	25~320	6	1m	300	6	†1.1		
2SC931		High Power Amp Output Stage	2SD330 (T0220AB)	—	S, TME	50	50	4	3	†10	125	20	50μ	3	1m	2	1	—	25~200	5	0.5	120	5	100		
2SC931Z		High Power Switching	2SD330 (T0220AB)	—	S, TME	50	50	4	3	†10	125	20	50μ	3	1m	2	1	—	25~200	5	0.5	8	5	100		
2SC932		High Power Amp Output Stage	2SD330 (T0220AB)	—	S, TME	30	20	4	3	†10	125	20	50μ	3	1m	2	1	—	25~200	5	0.5	120	5	100		
2SC933	104	LF Amp, Transceiver Output		—	S, EPL	50	30	5	300m	200m	125	45	1μ	4	1μ	5	20m	—	40~560	10	20m	500	10	5		
2SC933	FP	LF Amp, Transceiver Output		—	S, EPL	50	30	5	300m	200m	125	45	1μ	4	1μ	5	20m	—	40~560	—	—	—	—	—		
2SC934	104	LF Amp, Transceiver Output		—	S, EPL	20	15	5	300m	200m	125	15	1μ	4	1μ	5	20m	—	40~560	10	20m	500	—	5		
2SC934	FP	LF Amp, Transceiver Output		—	S, EPL	20	15	5	300m	300m	125	15	1μ	4	1μ	5	20m	—	40~560	—	—	—	—	—		
2SC934	NP	LF Amp, Transceiver Output		2003	S, EPL	20	15	5	300m	300m	125	15	1μ	4	1μ	5	20m	—	40~560	—	—	—	—	—		
2SC972		LF Amp		—	S, EPL	70	70	5	400m	600m	150	70	10μ	5	10μ	4	0.2	—	40~200	4	10m	80	—	—		
2SC1024		High Power Amp Output Stage		—	S, TME	60	50	4	3	†25	150	55	1m	3	1m	2	1	—	25~200	—	—	—	—	—		
2SC1025		TV Hori., Ver. Output		—	S, TME	200	120	6	3	†25	150	180	1m	5	5m	2	0.5	—	40~320	5	0.5	8	—	—		
2SC1027		TV Hori. Output Stage		—	S, ME	250	80	5	6	†50	150	30	1m	(5)	(1m)	2	5	—	>9	—	—	—	—	—		

Type Number	Discontinued Package	Applications	Replacement	Case Outline	Structure	Absolute Maximum Ratings/Ta=25°C						Electrical Characteristics/Ta=25°C														Remarks
						V _{CB0}	V _{CE0} † V _{CEr}	V _{EB0}	I _c	P _c	T _{j(max)}	V _{CB}	I _{CB0} max	V _{EB}	I _{EB0} max	V _{CE}	I _c	f	h _{FE} † h _{FEr}	V _{CB} V _{CE}	I _c	f _r † f _{gb}	V _{CB}	c _{ob} † c _{re}		
2SC1035		UHF RF, Converter		—	S, TDP	30	15	3	20m	150m	125	25	1μ	3	1μ	6	1m	—	40~200	6	3	>540	6	†0.45	†T _c = 70°C	
2SC1036		UHF RF, Converter		—	S, TDP	30	15	3	20m	150m	125	25	1μ	3	1μ	6	1m	—	40~200	6	3	>540	6	†0.45	†T _c = 70°C	
2SC1045		Line Operate, Ver. Output Stage, High Voltage Power Amp		—	S, TDP	1000	550	5	1	†25	125	100	5μ	—	—	15	0.2	—	25~200	—	—	—	—	—		
2SC1045S		Switching, High Voltage Power Amp		—	S, TDP	1000	500	5	1	†25	125	1000	1m	(5)	(1m)	5	0.2	—	25~200	15	0.2	3	10	65		
2SC1046		Line Operate, Hori. Output Stage, High Voltage Power Amp		—	S, TDP	1000	400	6	3	†25	125	100	5μ	—	—	5	2	—	4~20	—	—	—	—	—		
2SC1046S		Switching, Hori. Output Stage, High Voltage Power Amp		—	S, TDP	1000	400	6	3	†25	125	1000	1m	(6)	(1m)	15	0.2	—	8~80	15	0.2	2	—	—		
2SC1048		Video Output, Chroma Output	2SC1756	—	S, ME	200	200	6	50m	600m	150	100	10μ	—	—	10	25m	—	40~200	10	10m	120	10	3.5		
2SC1048S		High Voltage Switching, Video, Chroma Output		—	S, ME	200	200	6	50m	600m	150	100	1μ	5	1μ	10	25m	—	40~320	10	10m	120	10	3.5		
2SC1050		TV Sound Output, Power Supply Control	2SD1401	—	S, TME	300	300	6	1	†40	150	150	1m	6	5m	5	300m	—	40~320	5	300m	5	—	—		
2SC1051		LF Power Amp	2SC3088	—	S, TME	150	100	6	7	†60	150	30	1m	6	5m	5	1	—	40~320	5	1	8	—	—		
2SC1051L		LF Power Amp	2SC3088	—	S, TME	100	80	6	7	†60	150	30	1m	6	5m	5	1	—	40~320	5	1	8	—	—		
2SC1175		LF Power Amp	2SC2274	2003A	S, TDP	50	50	5	200m	400m	125	40	10μ	3	10μ	6	50m	—	40~320	6	10m	170	—	—		
2SC1175	FP	LF Small Signal Amp		—	S, TDP	50	50	5	200m	400m	125	40	10μ	3	10μ	6	50m	—	40~320	6	10m	170	—	—		
2SC1175S	FP	LF Small Signal Amp		—	S, TDP	50	50	5	200m	300m	125	40	0.1μ	4	0.1μ	6	50m	—	40~320	6	10m	170	—	—		
2SC1180		UHF RF Amp		—	S, TDP	30	20	3	20m	150m	150	25	1μ	2	1μ	6	1m	—	40~320	10	2m	800	10	†0.3		
2SC1181		Video IF Amp (Last Stage)		—	S, EPL	40	40	3	50m	300m	125	35	1μ	2	1μ	6	1m	—	15~120	6	1m	400	6	†1.0		
2SC1182		Video IF Amp (Last Stage)		—	S, EPL	25	25	3	50m	300m	125	20	1μ	2	1μ	6	1m	—	15~120	6	1m	400	6	†1.0		
2SC1235		Color TV Video Output	2SC1755	—	S, TDP	300	300	4	100m	†6.5	150	100	5μ	3.5	1m	10	50m	—	30~160	30	20m	60	10	7.5		
2SC1284		UHF, VHF OSC		—	S, EPL	30	20	3	50m	200m	125	20	0.1μ	2	0.1μ	6	1m	—	25~200	6	1m	700	10	†0.92		
2SC1285		HF Amp	2SC536 (SP, NP)	—	S, EPL	40	30	5	100m	200m	125	35	1μ	4	1μ	6	1m	—	40~560	6	1m	140	6	3.0		
2SC1285S		LF Small Signal Amp		—	S, EPL	55	50	5	100m	200m	125	18	0.1μ	4	0.1μ	1	10m	—	60~560	6	1m	140	6	2.9		
2SC1293	NP	TV Video IF Amp	—	2003A	S, EPL	25	25	3	50m	300m	125	20	1μ	2	1μ	6	1m	—	15~120	6	1m	400	6	†1.3		
2SC1293	FP	Video IF Amp (Last Stage)		—	S, EPL	25	25	3	50m	300m	125	20	1μ	2	1μ	6	1m	—	15~120	6	1m	400	6	†1.3		
2SC1295		TV Hori. Def. Output	2SD1400	2017	S, TME	1000	350	7	2	†40	150	100	0.1m	5	1m	5	1.5	—	<13	—	—	—	—	—		
2SC1296		16" to 18" Color TV Hori. Def. Output		—	S, TDP	1300	400	6	5	†50	150	100	100μ	5	1m	5	3.5	—	74	—	—	—	—	—		
2SC1308		20" Color TV Hori. Output	2SD1402	2017	S, TME	1500	400	6	7	†50	150	100	0.1m	5	1m	5	4	—	>3	—	—	—	—	—		
2SC1570	FP	Very Low Noise LF Amp	2SC1570 (NP)	—	S, EPL	55	50	5	100m	200m	125	18	0.1μ	3	0.1μ	6	1m	—	160~960	6	1m	100	6	3		

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						V _{CB0}	V _{CEO} † V _{CER}	V _{EBO}	I _c	P _c	T _j (max)	V _{CB}	I _{CB0} max		V _{EB}	I _{EBO} max		V _{CE}	I _c	f	h _{FE} † h _{fe}	V _{CB} V _{CE}	I _c	f _T		V _{CB}	c _{ob} † c _{re}	
													† f _{ab}	† f _{gh}														
2SC1571	FP	Very Low Noise LF Amp	2SC1571 (NP)	—	S,EPL	40	35	5	100m	200m	125	18	0.1μ	3	0.1μ	6	1m	—	160~960	6	1m	100	6	3				
2SC1571L	FP	Very Low Noise LF Amp	2SC1571L (NP)	—	S,EPL	40	35	5	100m	200m	125	18	0.1μ	3	0.1μ	6	1m	—	160~960	6	1m	100	6	3				
2SC2057		Color TV Video IF Amp	—	—	S,TDP	30	25	3	20m	250m	125	25	1μ	3	1μ	6	1m	—	40~200	6	3m	500	10	†0.6				
2SC2079		HF Power Amp	2SC2314	2008	S,EPL	100	80	5	700m	1	125	20	1μ	4	1μ	5	50m	—	60~320	10	50m	100	10	10				
2SC2228		TV Video Output	2SC2228A	2006	S,TDP	160	160	5	50m	750m	125	160	1μ	5	1μ	10	10m	—	40~320	30	10m	>50	10	<4.0				
2SC2363		LF Power Amp	2SC2909	2003A	S,EPL	120	100	5	50m	500m	125	80	1μ	4	1μ	6	1m	—	100~560	6	1m	130	10	1.8				
2SC2375		LF Power Amp	2SC2910	2006A	S,EPL	150	120	5	50m	900m	150	80	1μ	4	1μ	6	1m	—	100~560	6	1m	130	10	1.8				
2SC2441		LF Power Amp	2SC2911	2009	S,EPL	180	160	5	80m	1	150	120	1μ	4	1μ	5	10m	—	60~320	10	10m	150	10	2.7				
2SC3041		Switching Regulator	2SC3040	2017	S,TDP	500	400	7	8	†90	150	400	10μ	5	10μ	5	0.8	—	>15	10	0.8	20	10	80				
2SC3043		Switching Regulator	2SC3042	2017	S,TDP	500	400	7	12	†120	150	400	10μ	5	10μ	5	1.6	—	>15	10	1.6	20	10	160				
2SC3084		Switching Regulator	2SC3083	2017	S,TDP	500	400	7	6	†70	150	400	10μ	5	10μ	5	0.4	—	>15	10	0.4	20	10	40				
2SC3091		Switching Regulator	2SC3088	2017	S,TDP	800	500	7	4	†70	150	500	10μ	5	10μ	5	0.3	—	>10	10	0.3	18	10	40				
2SC3092		Switching Regulator	2SC3089	2017	S,TDP	800	500	7	7	†90	150	500	10μ	5	10μ	5	0.6	—	>10	10	0.6	18	10	80				
2SC3093		Switching Regulator	2SC3090	2017	S,TDP	800	500	7	10	†120	150	500	10μ	5	10μ	5	1.2	—	>10	10	1.2	18	10	160				
2SC3094		Switching Regulator	—	2017	S,TDP	800	500	7	20	†160	150	400	10μ	5	10μ	5	2.4	—	>15	10	2.4	18	10	320				
2SC3154		Switching Regulator	2SC3151	2017	S,TDP	900	800	7	1.5	†70	150	800	10μ	5	10μ	5	0.1	—	>10	10	0.1	15	10	30				
2SC3155		Switching Regulator	2SC3152	2017	S,TDP	900	800	7	3	†90	150	800	10μ	5	10μ	5	0.2	—	>10	10	0.2	15	10	60				
2SC3156		Switching Regulator	2SC3153	2017	S,TDP	900	800	7	6	†120	150	800	10μ	5	10μ	5	0.4	—	>10	10	0.4	15	10	120				
2SD24		Line Operate LF Power Amp	—	—	S, ME	55	50	5	100m	200m	125	18	0.1μ	5	0.1μ	6	1m	—	100~850	6	1m	140	6	3.0				
2SD24Ⓢ		LF High Voltage Amp	—	—	S, ME	300	†300 (2.7kΩ)	4	100m	! 6.0	110	100	1μ	2	100μ	10	50m	—	60	30	20m	25	10	17		†Tc=70°C		
2SD24Y		Line Operate LF Power Amp	—	—	S,TME	300	†300 (2.7kΩ)	4	150m	! 6.5	150	100	1.5μ	4	100μ	10	50m	—	30~250	30	20m	8	10	12		†Tc=70°C		
2SD24YⓈ		High Voltage LF Power Amp	—	—	S,TME	300	300	4	150m	! 6.5	150	100	1μ	4	100μ	10	50m	—	30~250	30	20m	8	10	12		†Tc=70°C		
2SD30		LF Power Amp	—	—	G, AL	25	—	12	200m	±300m	85	20	15μ	6	12μ	1.5	100m	—	67~275	6	1m	†1	—	—		: With R1A fin		
2SD30Ⓢ		LF Power Amp	—	—	G, AL	40	25	12	200m	±300m	85	30	15μ	6	15μ	1.5	0.1	—	100	6	1m	†1	—	—	: With R1A fin			
2SD67		LF Power Amp	—	—	S, ME	120	†120 (100Ω)	5	5	†50	150	100	5m	4	5m	5	1	—	25~200	5	1	100	5	150				
2SD68		LF Power Amp	—	—	S, ME	75	†75 (100Ω)	5	5	†50	150	60	5m	4	5m	5	1	—	50~200	5	1	100	5	150				
2SD72		LF Power Amp	—	—	G, AL	25	†25 (100Ω)	6	600m	†720m	85	20	25μ	4	25μ	1	0.2	—	50~275	1	0.2	†0.75	—	—				

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						V _{CB0}	V _{CE0} † V _{CEr}	V _{EB0}	I _c	P _c	T _{j(max)}	V _{CB}	I _{CB0} max	V _{EB}	I _{EB0} max	V _{CE}	I _c	f	h _{FE} † h _{fe}	V _{CB} V _{CE}	I _c	f _r † f _{gh}	V _{CB}	c _{ob} † c _{rr}		
2SD72Ⓔ		LF Power Amp		—	G, AL	40	25	6	600m	†720m	85	130	30 μ	6	20 μ	1	0.2	—	100	1	0.2	†0.75	—	—		
2SD186		LF Small Signal Amp		—	G, AL	25	—	12	150m	200m	85	20	15 μ	6	12 μ	6	1m	1k	†	120	6	1m	†1	—	—	
2SD187		LF Power Amp		—	G, AL	25	—	12	150m	200m	85	20	15 μ	6	12 μ	1.5	30m	—	50 ~ 220	6	1m	†1	—	—		
2SD187Ⓔ		LF Power Amp		—	G, AL	40	25	12	150m	200m	85	30	15 μ	6	15 μ	1.5	30m	—	100	6	1m	†1	—	—		
2SD313	Old TO220	LF Power Amp	2SD313 (TO220AB)	—	S,TDP	60	60	5	3	†30	150	20	0.1m	4	1m	2	1	—	40 ~ 320	5	0.5	8	10	65		
2SD314	Old TO220	LF Power Amp	2SD314 (TO220AA)	—	S,TDP	60	60	5	3	†30	150	120	0.1m	4	1m	2	1	—	40 ~ 320	5	0.5	8	10	65		
2SD315		LF Power Amp		—	S, ME	60	60	5	4	†35	150	20	0.1m	4	1m	2	1	—	40 ~ 320	5	0.5	8	—	—		
2SD320		Color TV Power Supply Control		—	S,TDP	300	230	6	2	†50	150	100	0.1m	5	1m	15	1	—	10 ~ 50	—	—	—	—	—		
2SD325	Old TO220	LF Power Amp	2SD325 (TO220AB)	—	S,TDP	35	35	5	1.5	†10	150	20	0.1m	4	1m	2	1	—	40 ~ 320	5	0.5	8	—	—		
2SD330	Old TO220	LF High Power Amp	2SD330 (TO220AB)	—	S,TDP	50	50	5	2	†20	150	20	0.1m	4	1m	2	1	—	40 ~ 320	5	0.5	8	—	—		
2SD331	Old TO220	LF High Power Amp	2SD331 (TO220AA)	—	S,TDP	50	50	5	2	†20	150	20	0.1m	4	1m	2	1	—	40 ~ 320	5	0.5	8	—	—		
2SD332		LF Power Amp		2016	S, DJ	130	100	10	7	†65	150	50	1m	5	5m	5	1	—	40 ~ 200	—	—	—	—	—		
2SD348		20" 110° TV Hori. Def. Output	2SD1403	2017	S,TME	1500	400	6	7	†50	150	1000	0.1m	6	1m	5	5	—	>4.5	—	—	—	—	—		
2SD353		20" 110° TV Ver. Output	2SD386	—	S,TME	150	150	6	2	†60	150	30	10 μ	6	1m	5	0.1	—	>40	5	1	8	—	—		
2SD368		20" Color TV Hori. Output		—	S,TDP	1300	400	6	7	†50	150	100	0.1m	5	1m	5	4	—	75	—	—	—	—	—		
2SD386	Old TO220	TV Ver. Output	2SD386 (TO220AB)	—	S,TDP	200	120	6	3	†25	150	180	1m	5	5m	2	0.5	—	40 ~ 320	5	0.5	8	—	—		
2SD386A	Old TO220	TV Ver. Output	2SD386A (TO220AB)	—	S,TDP	200	150	6	2	†25	150	180	1m	5	5m	2	0.5	—	40 ~ 320	5	0.5	8	—	—		
2SD387	Old TO220	TV Ver. Output	2SD387 (TO220AA)	—	S,TDP	200	120	6	3	†25	150	180	1m	5	5m	2	0.5	—	40 ~ 320	5	0.5	8	—	—		
2SD387A	Old TO220	TV Ver. Output	2SD387A (TO220AA)	—	S,TDP	200	150	6	2	†25	150	180	1m	5	5m	2	0.5	—	40 ~ 320	5	0.5	8	—	—		
2SD400	Larger FP	Cassette Tape Recorder Power Amp, Electronic Governor	2SD400 (MP)	—	S,EPL	25	25	5	1	750m	125	20	1.0 μ	4	1.0 μ	2	50m	—	60 ~ 320	10	50m	180	10	15		
2SD400(P1)	Larger FP	Cassette Tape Recorder Power Amp, Electronic Governor		—	S,EPL	25	25	5	1	1	125	20	1.0 μ	4	1.0 μ	2	50m	—	60 ~ 320	10	50m	180	10	15	With P1 fin	
2SD400(P2)	Larger FP	Cassette Tape Recorder Power Amp, Electronic Governor		—	S,EPL	25	25	5	1	1	125	20	1.0 μ	4	1.0 μ	2	50m	—	60 ~ 320	10	50m	180	10	15	With P2 fin	
2SD416		20" 110° Hori. Def. Output		—	S,TDP	1500	400	6	7	†50	150	100	0.1m	6	1m	5	5.5	—	>3.5	—	—	—	—	—		
2SD437		Switching Regulator, Ignitor		—	S,TME	600	400	6	10	†80	150	400	0.1m	6	0.1m	5	6	—	>7	5	0.5	2.5	—	—		
2SD437W		High Voltage, Medium Speed Switching Regulator		2017	S,TME	500	350	6	10	†80	150	300	0.1m	5	0.1m	5	2	—	25 ~ 200	5	0.5	2.5	5	280		
2SD439	Larger FP	LF Power Amp, Medium Speed Switching	2SD439 (TO126)	—	S,EPL	60	50	5	0.7	750m	125	20	1.0 μ	4	1.0 μ	5	50m	—	60 ~ 320	10	50m	100	10	10		
2SD575		Color TV Hori. Output	2SD1400	2017	S,TME	1400	600	5	2.5	†50	150	1000	50 μ	5	5m	5	2	—	>2.5	—	—	—	—	—		

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						V _{CBO}	V _{CEO} † V _{CER}	V _{EBO}	I _c	P _c	T _j (max)	V _{CB}		I _{CBO}		V _{EB}		I _{EBO}		V _{CE}			I _c	f		h _{FE} † h _{fe}	V _{CB}		I _c	fr † f _{ab}	V _{CB}	c _{ob} † c _{re}	
												V _{CB}	I _{CBO} max	V _{EB}	I _{EBO} max	V _{CE}	I _c	V _{CB}	I _c	V _{CB}	I _c	V _{CB}					I _c	V _{CB}				I _c	V _{CB}
2SD613P		LF Power Amp, 25 to 35W Output		—	S,EPL	100	85	6	6	†50	150	40	0.1m	4	0.1m	5	1	—	40~320	5	1	15	10	110									
2SD616		LF Power Amp		—	S,EME	120	100	6	7	†60	150	80	0.1m	4	0.1m	5	1	—	40~320	5	1	15	—	—									
2SD621		TV Very High Voltage Hori. Output		2017	S,TME	2500	900	6	3	†50	150	1000	50μ	6	1m	10	1.5	—	>3	—	—	—	—	—									
2SD626		Electronic Ignition System		2017	S, TD	600	350	6	6	†80	150	350	0.1m	—	—	2	3.5	—	>300	—	—	—	—	—									
2SD627		Small Aperture Color TV Hori. Output	2SD1400	2017	S, TD	1500	600	6	3	†50	150	1000	50μ	6	1m	10	2	—	5~25	—	—	—	—	—									
2SD732		LF Power Amp	2SD1046	—	S,EME	150	120	6	8	†80	150	80	0.1m	4	0.1m	5	1	—	40~320	5	1	15	—	—									
2SD732K		LF Power Amp	2SD1046	—	S,EME	150	140	6	8	†80	150	80	0.1m	4	0.1m	5	1	—	40~320	5	1	15	—	—									
2SD733		LF Power Amp	2SD1047	2017	S,EME	160	140	6	12	†100	150	80	0.1m	4	0.1m	5	1	—	40~320	5	1	15	—	—									
2SD733K		LF Power Amp	2SD1047	2017	S,EME	180	160	6	12	†100	150	80	0.1m	4	0.1m	5	1	—	40~320	5	1	15	—	—									
2SD761		Color TV Ver., Sound Output	2SD1459	2013	S,TDP	180	180	6	1.5	†20	150	80	10μ	4	10μ	5	0.3	—	40~200	—	—	—	—	—									
2SD838		Very High Voltage Hori. Output		2017	S, TD	2500	900	6	3	†50	150	1000	50μ	6	1m	10	1.5	—	3~15	—	—	—	—	—									
2SD903		Color TV Hori. Output	2SD1398	2017	S,TME	1500	600	6	7	†50	150	1500	1m	4	100m	5	4	—	5~11.5	—	—	—	—	—									
2SD904		Color TV Hori. Output	2SD1398	2017	S,TME	1500	600	6	7	†50	150	1500	1m	4	100m	5	3	—	4~10	—	—	—	—	—									
2SD978		High Voltage Switching		2010A	S,TDP	450	350	6	5	†40	150	450	0.5m	4	10m	2	3	—	>100	—	—	—	—	—									
2SD979		High Voltage Switching		2022	S,TDP	450	350	6	10	†100	150	450	0.5m	4	20m	2	4	—	>200	—	—	—	—	—									
2SD993		Color TV Hori. Output	2SD1396	2017	S,TDP	1500	600	6	3	†50	150	1500	1m	4	133m	5	2	—	3~15	—	—	—	—	—									
2SD994		Color TV Hori. Output	2SD1399	2017	S,TDP	1500	600	6	8	†50	150	—	—	4	130m	5	5	—	3~15	—	—	—	—	—									
2SD995		Color TV Hori. Output		2017	S,TDP	2500	900	6	3	†50	150	—	—	4	130m	10	1.5	—	3~15	—	—	—	—	—									
2SD1059		LF Power Amp, 25W Output		2010	S, PL	100	85	6	6	†40	150	40	0.1m	4	0.1m	5	1	—	60~200	5	1	15	10	150									
2SD1231		Various Drivers	2SD1229	2017	S,EPL	70	60	6	10	†70	150	40	0.1m	5	3m	2	5	—	5000	5	5	20	—	—									
2SD1232		Various Drivers	2SD1193	2017	S,EPL	70	60	6	15	†80	150	40	0.1m	5	3m	2	7	—	5000	5	7	20	—	—									
2SD1233		Various Drivers	2SD1230	2017	S,EPL	110	100	6	8	†70	150	80	0.1m	5	3m	3	4	—	4000	5	4	20	—	—									
2SD1236		High Current Switching		2010A	S,EPL	120	80	6	5	†30	150	80	0.1m	4	0.1m	2	1	—	70~280	5	1	20	—	—									
2SD1237		High Current Switching		2010A	S,EPL	120	80	6	7	†40	150	80	0.1m	4	0.1m	2	1	—	70~280	5	1	20	—	—									
2SD1238		High Current Switching		2022	S,EPL	120	80	6	12	†80	150	80	0.1m	4	0.1m	2	1	—	70~280	5	1	20	—	—									
2SD1371		Power Supply Output		2010A	S,TDP	300	300	7	2	†40	150	200	100μ	7	100μ	5	0.3	—	>35	10	0.3	5	—	—									
2SD1372		Power Supply Output		2010A	S,TDP	300	300	7	4	†50	150	200	100μ	7	100μ	5	1	—	>35	10	1	5	—	—									

Type Number	Discontinued Package	Applications	Replacement	Case Outline	Structure	Absolute Maximum Ratings/Ta=25°C						Electrical Characteristics/Ta=25°C											Remarks		
						V _{CB0}	V _{CEO} † V _{CER}	V _{EBO}	I _c	P _c	T _j (max)	V _{CB}		I _{EBO}		h _{FE} † h _{fe}			V _{CB}		f _T † f _{ab}	V _{CB}		c _{ob} † c _{re}	
												max	max	V _{CE}	I _c	f	V _{CE}	I _c							
2SD1373		Power Supply Output		2022	S,TDP	300	300	7	3	†50	150	200	100μ	7	100μ	5	0.3	—	>35	10	0.3	5	—	—	

FET (N Channel Field Effect Transistors)

Type Number	Discontinued Package	Applications	Replacement	Case Outline	Structure	Absolute Maximum Ratings/Ta=25°C						Electrical Characteristics/Ta=25°C			Remarks
						V _{DSS}	V _{GDS} ■ V _{GDO}	V _{GSO}	I _G	P _D	T _j (max)	I _{DSS} /V _{DS}	gm/V _{DS}	NF/V _{DS} , f	
						V	V	V	A	W	°C	mA/V	mS/V	dB/V, Hz	
2SK24	FP RE3 SP	AF Small Signal Amp, AM RF Amp	2SK41 (NP) 2SK41 (NP)	—	S, N-J	—	40	—	10m	100m	125	0.6~24/10	7 / 10	1.0/10, 1 k	
2SK25		—		S, N-J	18	18	18	10m	100m	125	0.6~24/10	6 / 10	2.5/10, 100M		
2SK41		—		S, N-J	—	■ 18	—	10m	200m	125	0.6~24/10	7 / 10	3.5max/10, 100M		
2SK44		Capacitor Microphone	—	S, N-J	20	20	—	10m	100m	125	0.06~3.0/10	2 / 10	—		
2SK44		Capacitor Microphone	2SK304	2001B	S, N-J	20	20	—	10m	100m	125	0.06~3.0/10	2 / 10	—	
2SK331		Capacitor Microphone	2SK597	2026	S, N-J	—	■ 20	—	10m	100m	125	0.06~1.5/10	—	—	
2SK336		Analog Switch	2SK583	2005A	S, N-J	—	—	—	—	600m	125	< 1 μA/20	—	—	
3SK108		HF Amp	—	2031A	S, N-J	—	—	—	—	250m	125	—	—	1.8/10, 100M	

■ QUICK SELECTION GUIDE

	CP TYPE TRANSISTORS										DP TYPE TRANSISTORS						SP TYPE TRANSISTORS • SPA TYPE							
V_{CE0} (V) I_C (mA)	12	15	16	20	25	30	40	50	80	160	12	20	40	50	80	120	15	20	25	30	40	50	V_{CE0} (V) I_C (mA)	
5							K545																	5
10		K436 K443		K242 K334		K303			K283			K377	K332		K333		K427● K444●	K44 K156 K212 K315 K376 K404 K596		K304	K546			10
20				K543														K544						20
30		D1161		A1256 C2813 C2814 C3142								3SK107						A1177 C930 C2839 C2999 C2840						30
50																A1239 A1240 C3066 C3067								50
80										A1257 C3143														80
100								A1341 A1342 A1343 A1344 C3395 C3396 C3397 C3398												A608 C536		A1345● A1346● A1347● A1348● C3399● C3400● C3401● C3402●	100	
150								A1179 A1252 A1331 C2812 C3134 C3361						A1237 A1238 C3064 C3065								C2960		150
200																						A1253 A1317 C3135 C3330		200
300																			C3576					300
500								A1338 C3392														A1339 C3393		500
700		B815 D1048															B808 D1012							700

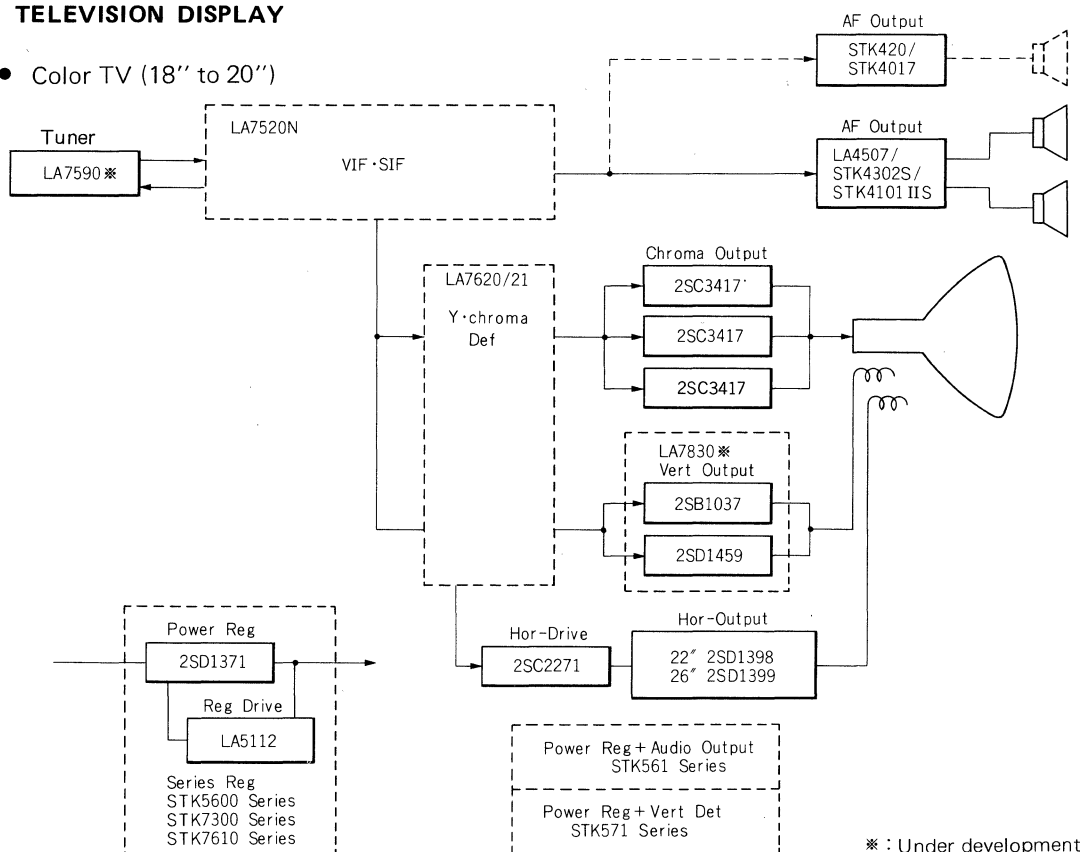
Note: "2S" in Type Nos. is omitted (except 3SK type). For FET's, V_{GDO}, V_{GDS}, V_{DSS} replace V_{CE0} and I_G replaces I_C. The same shall apply hereinafter.

[illegible]

RECOMMENDED BLOCK DIAGRAMS

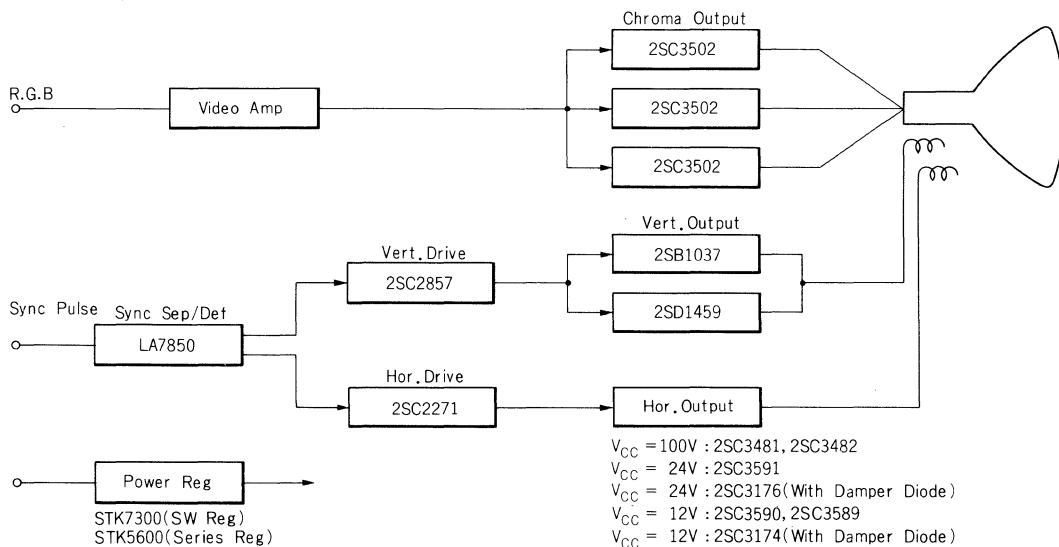
TELEVISION DISPLAY

- Color TV (18" to 20")



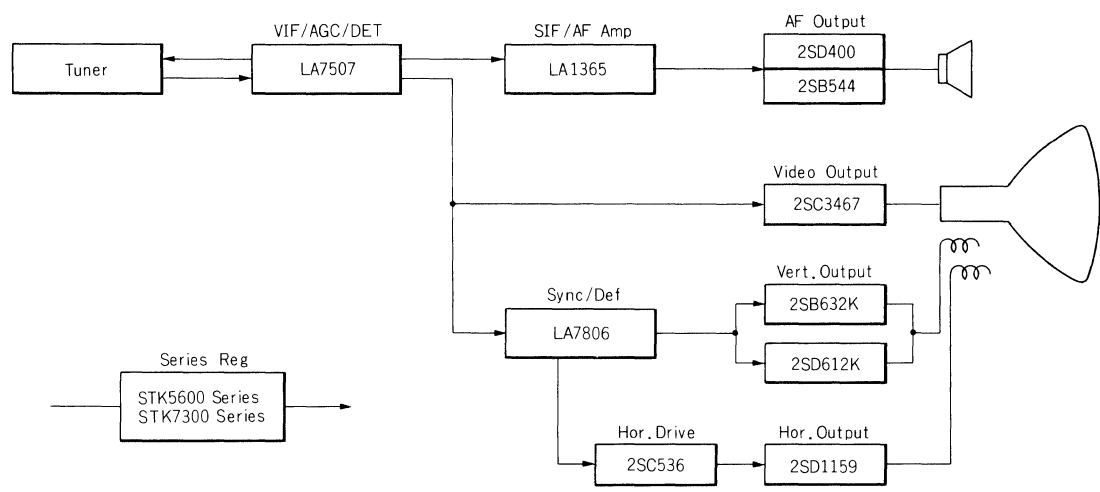
* : Under development

- Color Display (9" to 14")



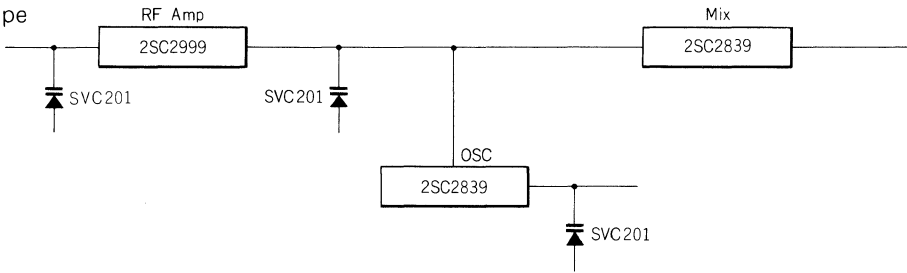
$V_{CC} = 100V$: 2SC3481, 2SC3482
 $V_{CC} = 24V$: 2SC3591
 $V_{CC} = 24V$: 2SC3176(With Damper Diode)
 $V_{CC} = 12V$: 2SC3590, 2SC3589
 $V_{CC} = 12V$: 2SC3174(With Damper Diode)

- B/W TV (10'' to 12'')

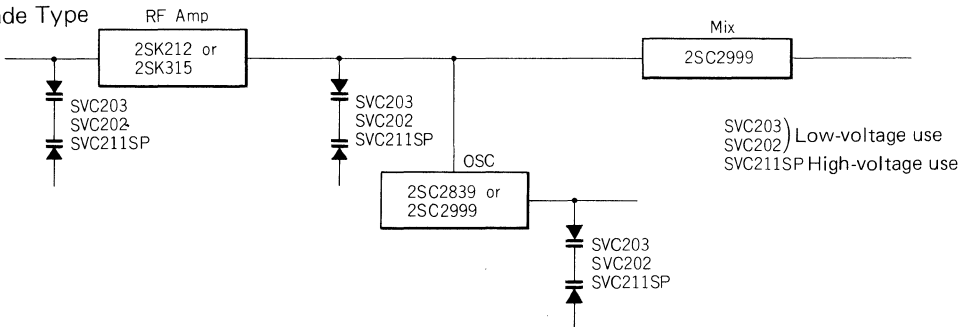


FM TUNERS

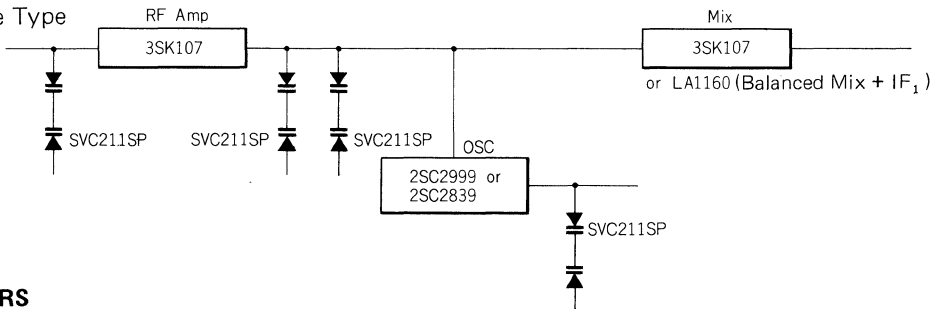
- Popular Type



- Middle-Grade Type

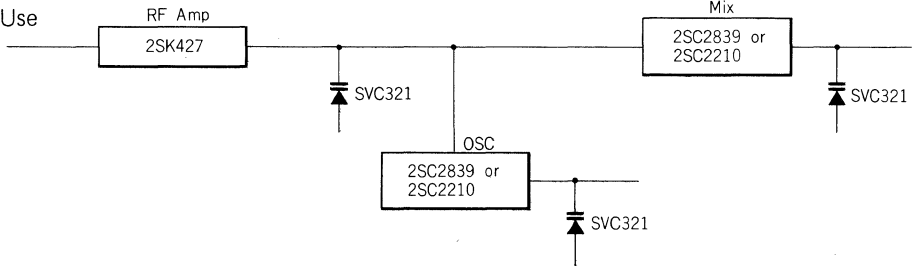


- High-Grade Type

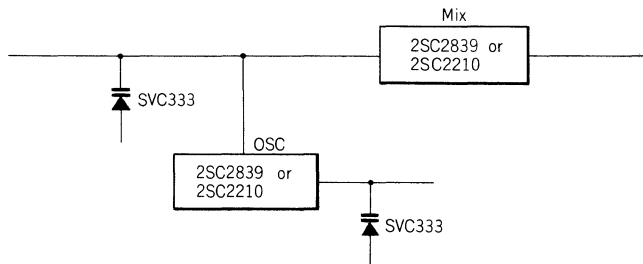


AM TUNERS

- Car Radio Use

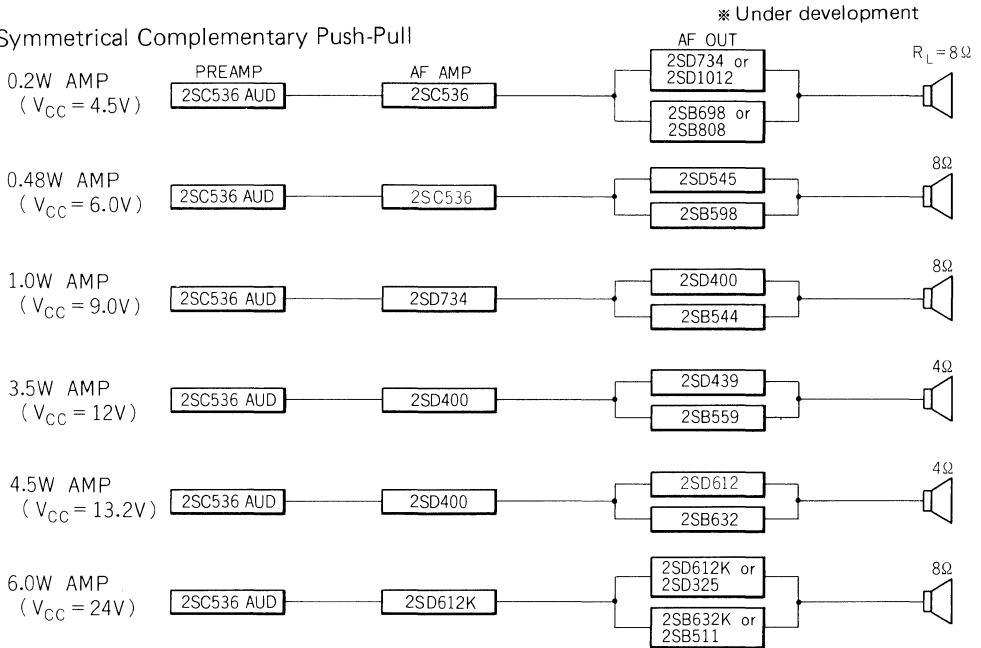


- Home Radio Use

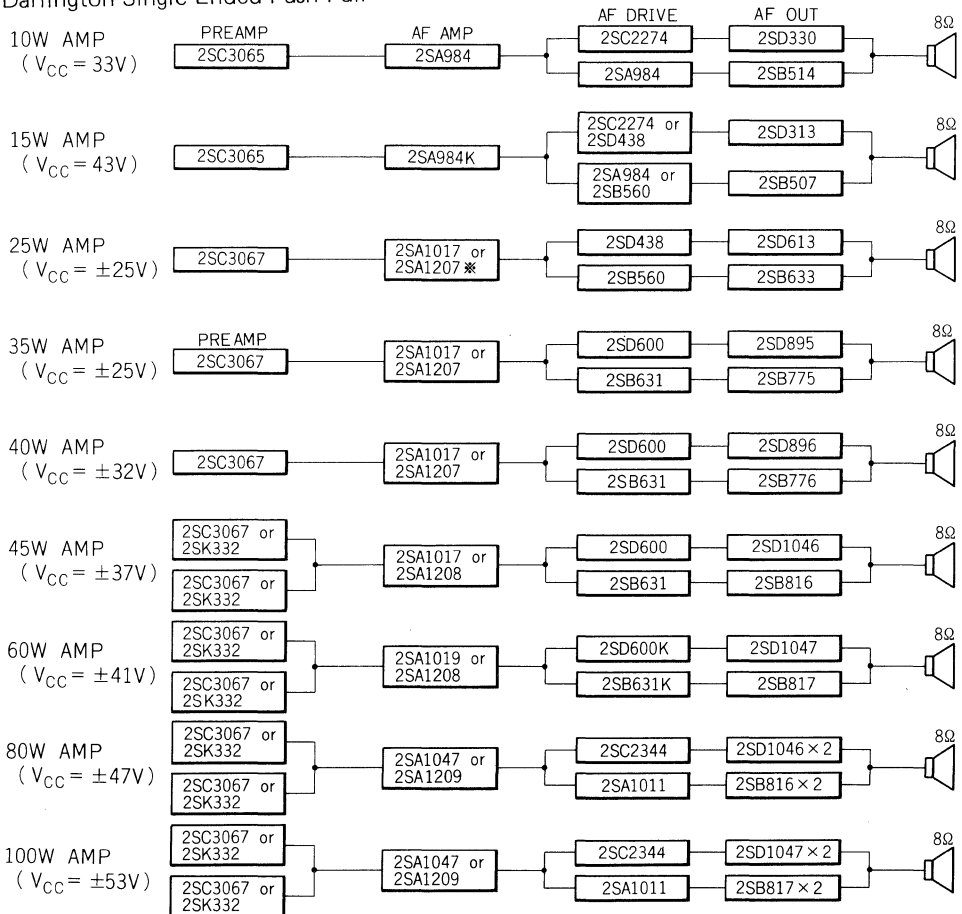


AUDIO AMP'S

(a) Symmetrical Complementary Push-Pull



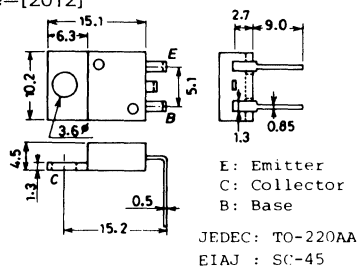
(b) Darlington Single Ended Push-Pull



CASE OUTLINES

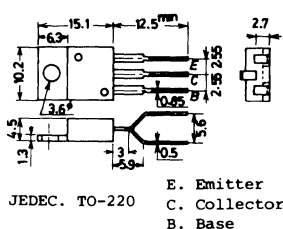
Case Outline—[2012]

unit:mm



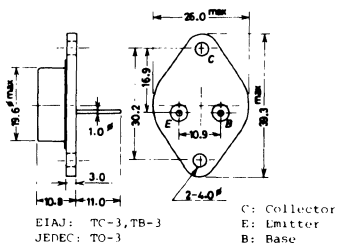
Case Outline—[2013]

unit:mm



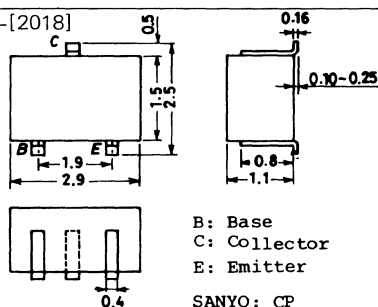
Case Outline—[2017]

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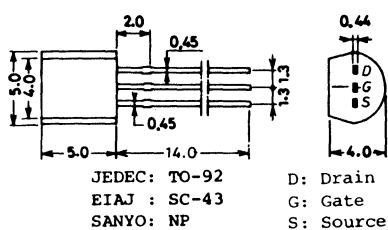
Case Outline—[2018]

unit:mm



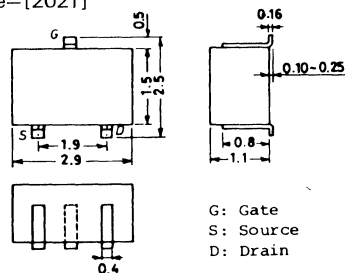
Case Outline—[2019A]

unit:mm



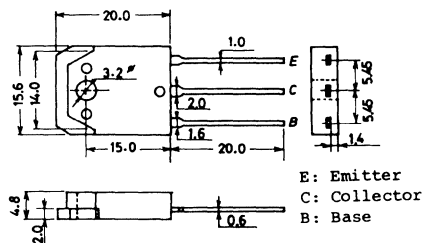
Case Outline—[2021]

unit:mm



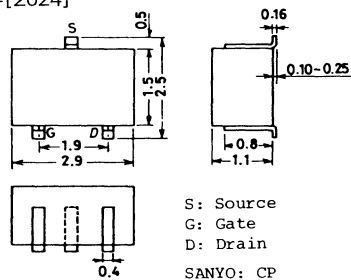
Case Outline—[2022]

unit:mm



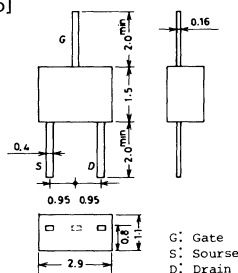
Case Outline—[2024]

unit:mm



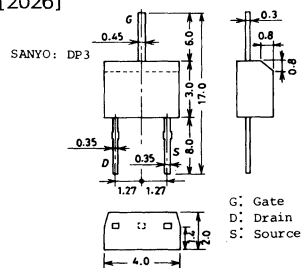
Case Outline—[2025]

unit:mm



Case Outline—[2026]

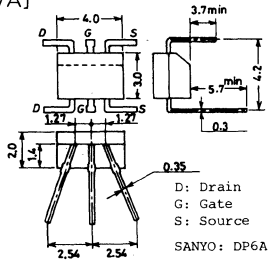
unit:mm



CASE OUTLINES

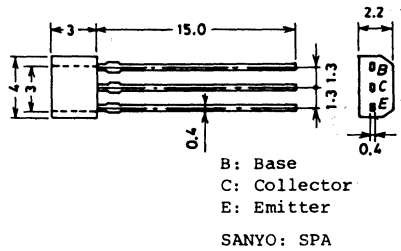
Case Outline—[2027A]

unit:mm



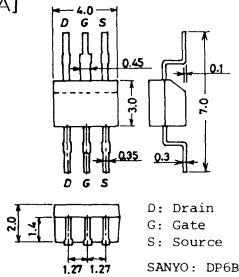
Case Outline—[2033]

unit:mm



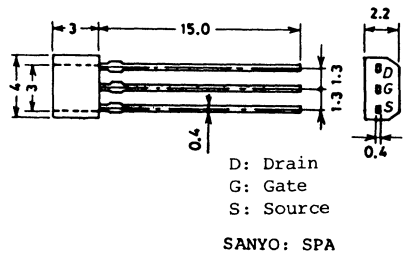
Case Outline—[2028A]

unit:mm



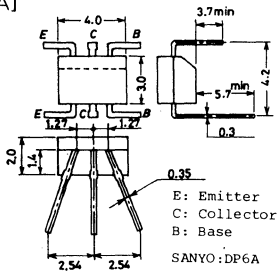
Case Outline—[2034]

unit:mm



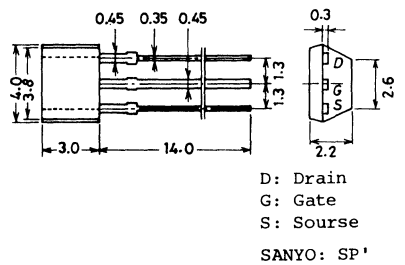
Case Outline—[2029A]

unit:mm



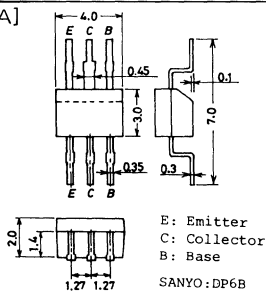
Case Outline—[2037]

unit:mm



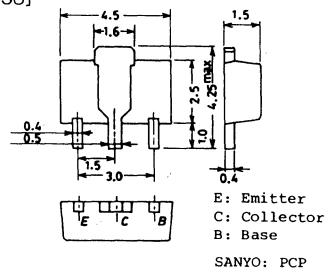
Case Outline—[2030A]

unit:mm



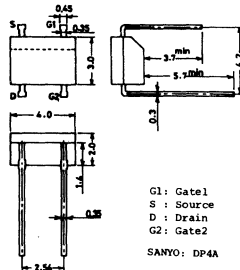
Case Outline—[2038]

unit:mm



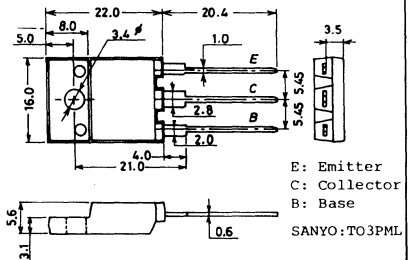
Case Outline—[2031A]

unit:mm

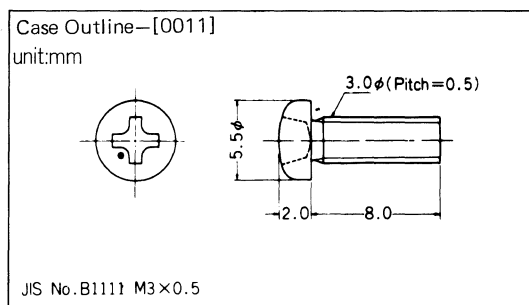
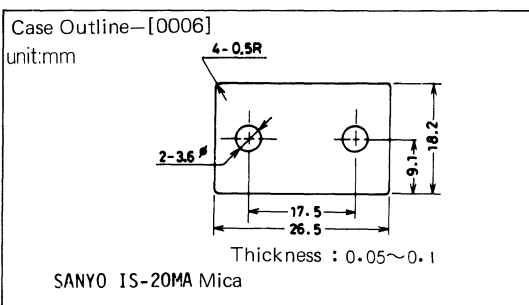
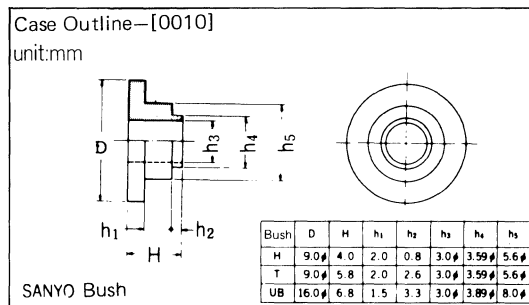
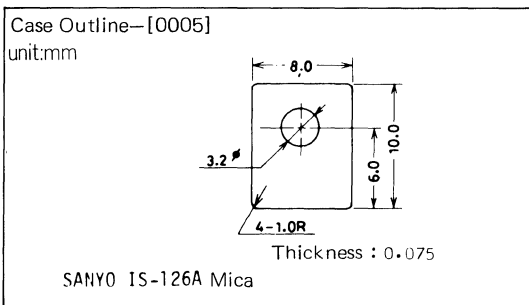
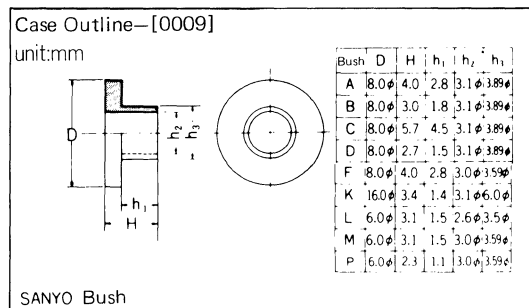
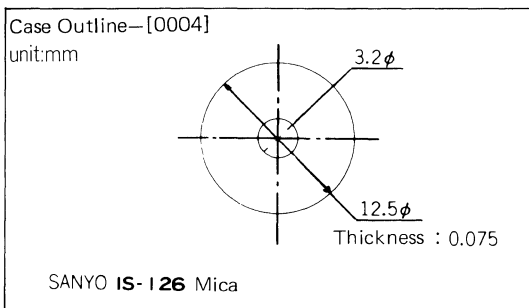
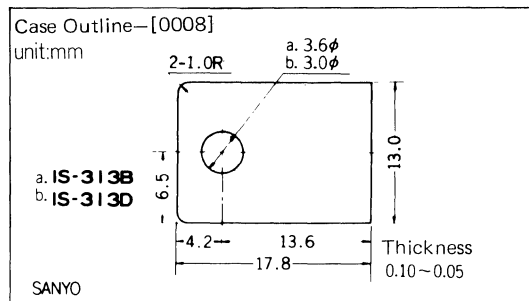
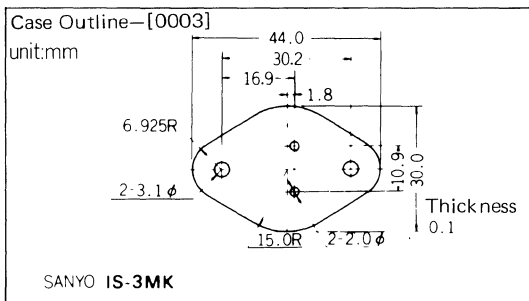
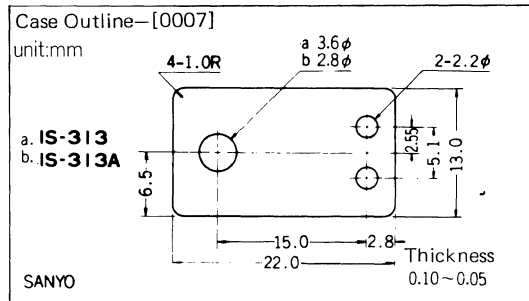
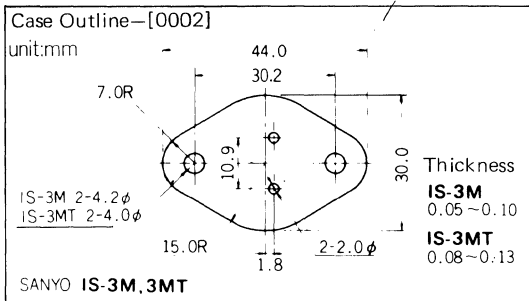


Case Outline—[2039]

unit:mm



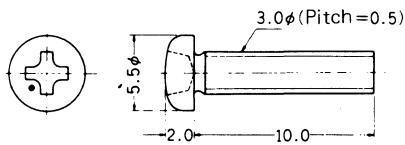
CASE OUTLINES



CASE OUTLINES

Case Outline—[0012]

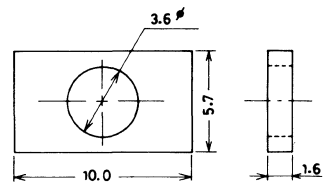
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JIS No. B1111 M3×0.5

Case Outline—[0017]

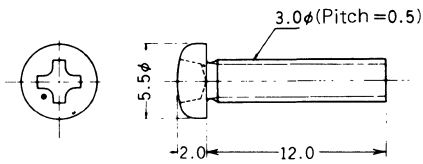
unit:mm



JIS No. G3141 Rectangular washer

Case Outline—[0013]

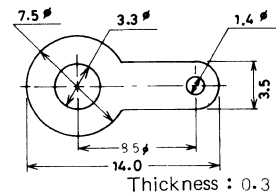
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JIS No. B1111 M3×0.5

Case Outline—[0018]

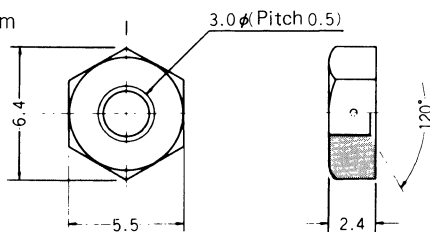
unit:mm



SANYO Lug 1.4

Case Outline—[0014]

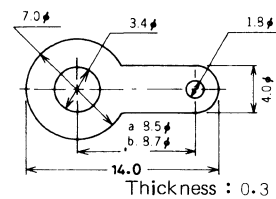
unit:mm



JIS No. B1181 M3×0.5

Case Outline—[0019]

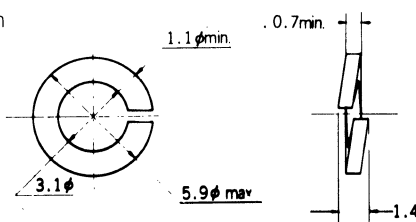
unit:mm



SANYO Lug 1.8φ

Case Outline—[0015]

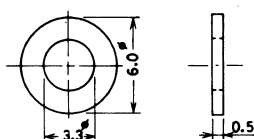
unit:mm



JIS No. B 1251 Spring washer (M3)

Case Outline—[0016]

unit:mm



JIS No. B1252 Flat washer

GENERAL INFORMATION

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2. Product Types and Symbols	47
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5. Thermal Design of Semiconductor Circuit . .	64
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2. PRODUCT TYPES

2.1 Product Types

This HANDBOOK contains technical data on semiconductor devices available from Tokyo Sanyo Semiconductor Division as standard products and also on semiconductor devices being developed (as of January, 1985) for inclusion in our standard products.

No technical data on custom-made semiconductor devices or optional semiconductor devices are presented in this HANDBOOK.

If the types or characteristics of semiconductor devices do not meet your requirements, you can ask consultation. We provide custom-made versions, new developments, and/or options of our semiconductor devices according to consultation.

[Table 2.1] Sanyo Semiconductor Device Numbering System

Type Number	Description	Registered with
LAXXXX	Monolithic bipolar linear IC	Sanyo
LBXXXX	Monolithic bipolar digital IC	Sanyo
LCXXXX	Monolithic C-MOS IC	Sanyo
LDXXXX	Thin film IC	Sanyo
LMXXXX	Monolithic P-MOS IC	Sanyo
STKXXX	Thick film IC	Sanyo
2SAXXX	High frequency PNP transistor	EIAJ
2SBXXX	Low frequency PNP transistor	EIAJ
2SCXXX	High frequency NPN transistor	EIAJ
2SDXXX	Low frequency NPN transistor	EIAJ
2SFXXXX	Reverse blocking thyristor	EIAJ
2SJXX	P-channel FET	EIAJ
2SKXX	N-channel FET	EIAJ
2SMXXX	Bidirectional thyristor	EIAJ
1SXXXX	Diode	EIAJ
TSXXX	Silicon transistor	Sanyo
TGXXX	Germanium transistor	Sanyo
DSXXX	Silicon diode	Sanyo
DGXXX	Germanium diode	Sanyo
SZXX	Reference diode	Sanyo
SZAXX	Reference diode	Sanyo
SDTXXX	Thermistor	Sanyo

2.2 Type Numbers

Type numbers in Table 2.1 are roughly divided into two groups: EIAJ numbers and Sanyo numbers.

(1) EIAJ (Electronic Industries Association of Japan) numbers

These are serial numbers registered with the Electronic Industries Association of Japan.

We use EIAJ numbers for discrete transistors only. Some numbers may be followed by A, B, C, etc. to classify the characteristic.

For semiconductor devices other than discrete transistors, we use Sanyo numbers described in (2) below.

(2) Sanyo numbers

Type numbers for integrated circuits are not standardized yet in the semiconductor industry. Each company has its own type numbers.

Sanyo numbers for discrete transistors are temporary ones, which are changed to EIAJ numbers after completion of their development unless there arise special circumstances.

For diodes, we use Sanyo numbers without changing to EIAJ numbers.

2.3 Symbols

Symbols are often used to represent the characteristics of semiconductor devices. A simple description is given to each symbol presented in this HANDBOOK. No description is given to symbols which are self-explanatory or are not commonly used.

Generally speaking, symbols and their suffixes are written in capital letters for DC characteristics and small letters for AC characteristics. This rule is observed in this HANDBOOK, with some exceptions.

Suffixes are used to give supplementary explanations to symbols.

Fundamental electrical symbols and symbols used to denote figures are defined by JIS. In this HANDBOOK, symbols shown below are used to denote figures.

Figure 10^9 10^6 10^3 10^0 10^{-3} 10^{-6} 10^{-9} 10^{-12}
Symbol G M k — m μ n p

The following are units and their symbols used in this HANDBOOK.

Voltage V
Current A
Power W
Impedance Ω

Admittance	S
Capacitance	F
Inductance	H
Time	sec (s), min, hour (h)
Frequency	Hz
Gain	dB
Phase angle	degree
Relative humidity	%
Temperature	°C

The following are symbols used in this HANDBOOK.

ASO	: Area of safe operation
c	: Junction capacitance in diode (unit: F)
$C_n V$	: Junction capacitance in varactor diode at nV (unit: F)
c_i, c_o	: Input, output capacitance respectively (unit: F)
c_{ob}	: Common-base output capacitance (unit: F)
CR	: Capacitance ratio (no unit)
c_{re}, c_{rb}	: Common-emitter, common-base reverse transfer capacitance respectively (unit: F)
f	: Frequency (unit: Hz)
$f_{\alpha b}$	: Common-base cutoff frequency (unit: Hz)
f_T	: Gain bandwidth product (unit: Hz)
g_m	: Mutual conductance (unit: S)
h_{FE}	: Common-emitter DC current gain (no unit)
h_{ie}	: Output-short input impedance (unit: Ω)
h_{re}	: Input-open reverse voltage transfer ratio (no unit)
h_{fe}	: Output-short current gain (no unit)
h_{oe}	: Input-open output admittance (unit: S)
I_B, I_C, I_E	: Base current, collector current, emitter current of transistor respectively (unit: A)
I_G, I_S, I_D	: Gate current, source current, drain current of FET respectively
I_{CCO}	: Quiescent current (unit: A)
i_{cp}	: Peak collector current (unit: A)
I_F	: Forward current in diode (unit: A)
$I_{FM}, I_{F(P)}$	: Peak forward current (unit: A)

I_O	: Average forward current in diode (unit: A)
I_R	: Reverse current (unit: A)
I_Z	: Zener current (unit: A)
I_{ZM}	: Maximum allowable zener current (unit: A)
I_{CBO}	: Collector cutoff current (unit: A)
I_{GSS}	: Gate cutoff current (unit: A)
I_{DSS}	: Gate-to-source short drain current (unit: A)
I_{FSM}, I_{surge}	: Surge current (unit: A)
MG	: Mixer gain (unit: dB)
n	: Number of cycles applied continuously in diode (no unit)
NF	: Noise figure (unit: dB)
P_C	: Collector dissipation (unit: W)
P_D	: Allowable power dissipation in FET (unit: W)
P	: Power dissipation in diode (unit: W)
P_O	: Output power (unit: W)
P_{peak}	: Peak allowable power dissipation (unit: W)
PG	: Power gain (unit: dB)
Q	: Quality factor (no unit)
R_{BE}	: External base-to-emitter resistance (unit: Ω)
r_d	: Dynamic resistance (unit: Ω)
r_i, r_o	: Input, output resistance respectively (unit: Ω)
$r_{bb'} C_c$	: Collector-to-base time constant (unit: sec)
r_s	: Equivalent series resistance in varactor diode (unit: Ω)
T_a	: Ambient temperature (unit: °C)
T_c	: Case temperature (unit: °C)
T_j	: Junction temperature (unit: °C)
T_{stg}	: Storage temperature (unit: °C)
t_{rr}	: Reverse recovery time (unit: sec)
t_f	: Fall time (unit: sec)
t_{on}	: Turn-on time = delay time t_d + rise time t_r (unit: sec)
t_{off}	: Turn-off time = storage time t_{stg} + fall time t_f (unit: sec)
t_{stg}	: Storage time (unit: sec)
THD	: Total harmonic distortion (no unit)

V_{CC}	: Supply voltage (unit: V)
V_{CEO}	: Collector-to-emitter voltage (unit: V)
$V_{CE(sat)}, V_{BE(sat)}$	: Collectot-to-emitter, base-to-emitter saturation voltage (unit: V)
V_{BE}	: Base-to-emitter (rise) voltage (unit: V)
V_F	: Forward voltage (unit: V)
$V_{GS(off)}$	: Gate-to-source cutoff voltage (unit: V)
V_R	: Reverse voltage (unit: V)
$V_{RM}, V_{R(P)}$	: Peak reverse voltage (unit: V)
V_Z	: Zener voltage (unit: V)
V_{NO}	: Output noise voltage (unit: V)
V_{NI}	: Equivalent input noise voltage (unit: V)
V_G	: Voltage gain (unit: dB)
Y_{ie}	: Output-short input admittance (unit: S)

Y_{re}	: Input-short reverse transfer admittance (unit: S)
Y_{fe}	: Output-short forward transfer admittance (unit: S)
Y_{oe}	: Input-short output admittance (unit: S)
γ_Z	: Temperature coefficient of zener voltage (unit: %/°C)
ΔC_m	: Matching tolerance of varactor diode (no unit)
η	: Detection efficiency (no unit, %)
θ	: Thermal resistance (unit: °C/W)

Besides the above-mentioned, the following established symbols are used. Ground-Gnd, load resistance- R_L , signal source resistance- R_g , switch-SW, input-IN (or in, input), output-OUT (or out, output), impedance elements-C, R, L, time-t, stability factor coefficient-S.

3. MAXIMUM RATINGS

For designing highly reliable electronic equipment, it is important not only to select highly reliable parts, but also to use them properly. To that end, it is essential, above all, to use parts within the limits of their absolute maximum ratings.

This chapter gives a detailed description of the maximum ratings of semiconductor devices.

3.1 Necessity of Maximum Ratings

Because of the exponential dependence of the carrier density in a semiconductor device on temperature, transistor function attributable to the behavior of carriers is significantly affected by temperature. In transistors, diodes, and integrated circuits having the PN junction, if a high voltage is applied to this junction, carriers receive energy and the cumulative multiplication of carriers may take place to cause an abrupt voltage breakdown phenomenon like electron avalanche. Current does not cause such an abrupt change as caused by voltage, but may cause gradual changes in characteristics, whereby a semiconductor device becomes functionally useless; and further, power dissipation at the junction, i.e. the product of current and voltage, may be converted into thermal energy, thereby leading to thermal breakdown of the semiconductor device. Thus, voltage, current, power dissipation, and temperature constitute important parameters which limit the operating functions of semiconductor devices.

It is necessary for the user to observe limiting values specified for voltage, current, power dissipation, and temperature applicable to any semiconductor device of a specified type. These limiting values are called "Maximum Ratings".

3.2 Meaning of Maximum Ratings

In general, maximum ratings are defined as absolute ratings which are required to guarantee reliability, e.g. life, etc. of semiconductor devices. With the performance of semiconductor devices being rapidly advanced, however, this definition has come not to meet the actual requirements, and Semiconductor Technical Committee and Semiconductor Integrated Circuit Technical Committee of EIAJ (Electronics Industries Association of Japan) are reviewing each item of absolute maximum ratings for the purpose of formulating the

definition. Our Semiconductor Division has determined absolute maximum ratings with the above-mentioned meaning of absolute maximum ratings of semiconductor devices fully considered.

Maximum ratings, being generally regarded as equivalent to absolute maximum ratings, are limiting values which must not be exceeded even for a moment under the worst probable conditions. If these values are exceeded, deterioration or breakdown may occur and characteristics may not be restored to normal. Further, any two of maximum ratings must not be reached simultaneously.

In determining maximum ratings, it is necessary to consider not only such properties of semiconductor chips as mentioned in 3.1, but also structural material other than semiconductor chip itself. In plastic molded devices, for example, the maximum rating of temperature depends on the heat-resisting property of plastic.

For circuit design, thermal design of electronic equipment, it is strictly prohibited to use semiconductor devices in a state where absolute maximum ratings are exceeded. This is the first step toward using semiconductor devices properly.

3.3. Maximum Ratings of Transistor

3.3.1 Maximum Voltage Ratings

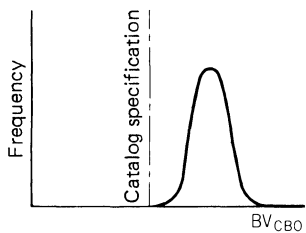
V_{CB0} represents the maximum reverse voltage that can be applied to the base-collector junction with emitter open. If this applied voltage is increased, the cumulative multiplication of carriers attributable to high electric field in space charge layer of the junction may cause electron avalanche to occur, thereby resulting in a very large current flow that may break down the transistor when the resistance of a limiting resistor is not large enough.

Avalanche multiplication factor M at the collector junction is given experimentally by Miller as follows:

$$M = \frac{1}{1 - (V_{CB}/V_A)^n} \dots\dots\dots (1)$$

where V_{CB} : Collector-base voltage
 V_A : V_{CB} at $M = \infty$, that is, V_A is the voltage at which electron avalanche causes collector current to flow on a large scale.

Maximum voltage rating V_{CBO} specified on catalogs is less than the above-mentioned V_A and is generally fixed with the variations in V_{CBO} of finished devices also considered as shown in Fig. 3.1.



[Fig. 3.1] Variations in BV_{CBO} and Catalog Specification

n in equation (1) differs with each type of transistor as shown in Table 3.1.

[Table 3.1]

Transistor	n
Germanium PNP type	3
Germanium NPN type	6
Silicon PNP type	4
Silicon NPN type	2

For alloy type transistors, V_A depends on the resistivity and width of base layer; and for diffused base type transistors, V_A depends on the diffusion depth and the resistivity and width of collector region. Generally, the larger this resistivity becomes, the higher V_A becomes.

The maximum reverse voltage to be applied to the emitter-base junction with collector open is BV_{EBO} . In normal transistors, BV_{EBO} is only several volts because of high impurity concentration in the vicinity of emitter junction.

Voltage breakdown which occurs at less than 6V is not due to the above-mentioned electron avalanche, but due to Zener breakdown caused by tunnel effect.

If a voltage exceeding BV_{EBO} is applied, deterioration in transistor characteristics or breakdown may occur.

Maximum voltages other than BV_{CBO} are approximated with the following equations using V_A and n .

$$BV_{CEO} \doteq V_A \cdot n \sqrt{1 - \alpha_0}$$

$$\doteq V_A \cdot n \sqrt{\frac{1}{\beta}} \dots \dots \dots (2)$$

where α_0 : Common base current amplification factor at voltage without avalanche multiplication
 β : Common emitter current amplification factor

$$BV_{CER} \doteq V_A \cdot n \sqrt{1 - \frac{I_{CBO} (R_{BE} + r_{bb'})}{V_d}}$$

$$\dots \dots \dots (3)$$

where R_{BE} : Resistor to be connected across base and emitter
 V_d : Forward rise voltage at base-emitter junction

$$BV_{CES} \doteq V_A \cdot n \sqrt{1 - \frac{I_{CBO} \cdot r_{bb'}}{V_d}} \dots \dots (4)$$

$$BV_{CEX} \doteq V_A \cdot n \sqrt{1 - \frac{I_{CBO} \cdot r_{bb'}}{V_d + V_X}} \dots \dots (5)$$

where V_X : Reverse voltage to be applied across base and emitter

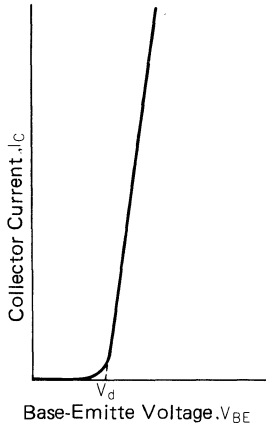
BV_{CEO} , being the avalanche breakdown voltage in the common emitter mode, occurs at a voltage at which β becomes infinite. For voltage affected by avalanche multiplication factor M , α_0 increases by a factor of M and the relation between β and α_0 is expressed as follows:

$$\beta = \frac{\alpha_0 M}{1 - \alpha_0 M} \dots \dots \dots (6)$$

Therefore, β becomes infinite at $\alpha_0 M = 1$, i.e. $M = 1/\alpha_0$ and the breakdown voltage in the common emitter mode occurs. If V_{CB} at $M = 1/\alpha_0$ in equation (1) is taken as BV_{CEO} , equation (2) is obtained.

Since the $V_{BE} - I_E$ characteristic is exponential as shown in Fig. 3.2, it is difficult to fix V_d exactly. Therefore, equations (3) to (5) also lack in exactness and it is advisable to use them as a rule-of-thumb guide. Fig. 3.3 (a) shows how BV_{CER} varies with R_{BE} . Large R_{BE} causes BV_{CER} to

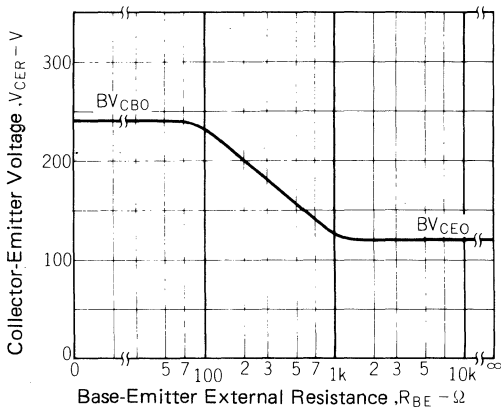
come close to BV_{CEO} ; and small BV_{CER} causes BV_{CER} to come close to BV_{CBO} . At the same



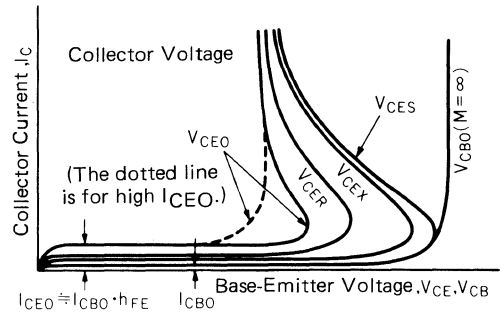
[Fig. 3.2] Explanation of Forward Rise Voltage V_d

time the collector-emitter cutoff current varies as shown in Fig. 3.3 (b). As the temperature rises, BV_{CBO} generally increases owing to the dependence of V_A on temperature, but BV_{CEO} does not always increase because the dependence of V_A and β on temperature is related to BV_{CEO} as shown in equation (2). In the range of current on which BV_{CEO} depends, the sign of the temperature coefficient of β is plus.

Fig. 3.3 (b) shows roughly how BV_{CBO} , BV_{CES} , BV_{CER} , BV_{CEO} , and BV_{CEX} are related to one another.



[Fig. 3.3 (a)] Dependence of Collector-Emitter Voltage on Base-Emitter External Resistance



[Fig. 3.3 (b)] Collector Breakdown Voltage under Various Conditions (The dotted line often occurs in germanium transistors.)

The value to which BV_{CEO} approaches infinitely at high I_C is sometimes called $V_{CE(SUS)}$. For high I_{CBO} typical of germanium transistors, etc., BV_{CEO} becomes as shown by the dotted line and negative resistance which occurs in silicon transistors may not occur.

3.3.2 Maximum Current Ratings

For maximum voltage ratings, a rather clear indication is available because an abrupt change in characteristics appears as mentioned in 3.3.1. For maximum current ratings, however, there is no such indication as breakdown caused by voltage. Normally, maximum current ratings are determined based on the following.

- (1) Collector current I_C at which DC current amplification factor h_{FE} drops to 1/2 or 1/3 of its peak value. For use in switching applications, collector current I_C at which DC current amplification factor h_{FE} becomes 10 and 3 for medium power transistor and high power transistor respectively
- (2) Current at which the internal power dissipation, i.e. the product of this current and collector saturation voltage, exceeds P_{Cmax}
- (3) Current at which the internal lead wire is burnt out
- (4) Current at which transistor function stops

For peak collector current i_{cp} , a pulse width and a repetition frequency are specified according to application and a current value is determined that causes no breakdown or characteristic deterioration under such conditions at absolute maximum rating T_j or less.

3.3.3 Maximum Temperature Ratings

(1) Junction temperature T_j

As mentioned above, transistor operation is sensitive to temperature. As the temperature rises, thermal agitation of semiconductor crystal becomes violent and a large number of electron-hole pairs are generated by this energy. If electron-hole pairs are generated much more than minority carriers, the property of an intrinsic semiconductor results, thereby stopping the normal operation of a semiconductor device. The surface phenomenon of a transistor affects transistor characteristics adversely; chemical change of the surface is also accelerated as the temperature rises. This is expressed by the well-known Arrhenius's equation as follows:

$$\exp(-E/kT_j) \dots\dots\dots (7)$$

where E : Activation energy
 k : Boltzmann's constant
 T_j : Junction temperature

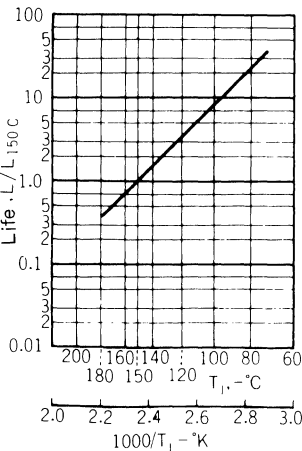
It is very important to limit the temperature to which a semiconductor device is subjected. The allowable temperature differs with semiconductor's energy gap E_g ; for germanium elements, a temperature of 75°C to 85°C is allowed and for silicon elements, a temperature of 150°C to 175°C is allowed. For the plastic molded type using silicon, however, the allowable temperature is normally limited to 125°C to 150°C because of the heat-resisting property of plastic.

The following relation between temperature T_j and life L of transistors is known empirically.

$$\ln L = A + \frac{B}{T_j} \dots\dots\dots (8)$$

where A, B : Constant

Fig. 3.4 shows this equation graphically. It is also clear from equation (7) that equation (8) should hold.



[Fig. 3.4] Dependence of Life of Silicon Power Transistor on Temperature

(2) Storage temperature T_{stg}

Junction temperature T_j in (1) is the temperature at which a semiconductor device can be safely operated. The temperature range in which a semiconductor device can be safely stored is specified as storage temperature T_{stg} .

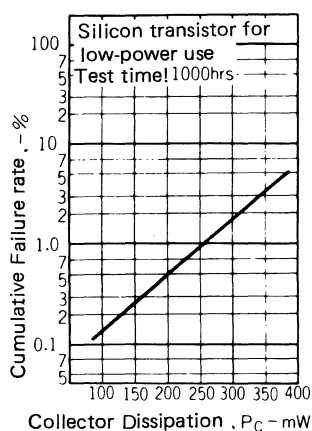
Normally, a maximum storage temperature is equal to a rated junction temperature. A minimum storage temperature is specified so that the difference in thermal expansion coefficient at various areas in a transistor causes no mechanical damage to the transistor.

3.3.4 Maximum Power Dissipation Rating (Collector Dissipation P_C)

Power dissipation in a transistor is converted into thermal energy, which raises junction temperature T_j . This means that it is necessary to limit collector dissipation. For that purpose, it may be necessary that a heat sink should be mounted, as mentioned later, to minimize thermal resistance of a transistor. Collector dissipation and junction temperature are closely related with each other as shown below.

$$T_j = \theta_T P_C + T_o \dots\dots\dots (9)$$

where θ_T : Thermal resistance
 P_C : Collector dissipation
 T_o : Reference temperature (Ambient temperature or case temperature)



[Fig. 3.5] Failure Rate Change with Collector Dissipation

Fig. 3.5 shows the failure rate obtained from an operating life test which is conducted by changing collector dissipation. Even if a transistor is used at the maximum junction temperature or maximum collector dissipation, the failure rate does not go higher abruptly, but when using a transistor, maximum ratings must not be exceeded from a viewpoint of reliability assurance. It is seen from equation (9) that junction temperature T_j depends on reference temperature T_o and self-heat generation by collector dissipation P_C .

Even if T_j remains the same, life L tends to be shortened when P_C accounts for a great deal. This is supposed to be due to the fact that an electric field is formed on the junction and ions remaining in the vicinity of the junction receive energy and move, which accelerates deterioration.

The maximum allowable collector dissipation of our transistors is determined as follows:

First, thermal resistance θ_T is measured and collector dissipation P_C is calculated at which junction temperature T_j becomes 75°C to 90°C for germanium transistors, 125°C to 175°C for metal case silicon transistors, and 110°C to 135°C for plastic molded silicon transistors. Then, a long operating life test is conducted based on this collector dissipation. The maximum allowable collector dissipation is determined from the results of this test. It is seen from this experiment that the failure rate depends on voltage, current even in case of the same collector dissipation. In general, the failure rate increases with an increase in voltage.

The absolute maximum collector dissipation rating is determined based on the following.

Absolute maximum ratings are limiting values which must not be exceeded even for a moment under the worst probable conditions to guarantee the characteristics and life of semiconductor devices. Our specifications for semiconductor devices specify the life assurance for using our semiconductor devices at absolute maximum ratings. In designing a circuit, the worst probable conditions of the following parameters should be considered and care should be taken that absolute maximum ratings must not be exceeded.

- (1) Supply voltage regulation
- (2) Variations in electrical characteristics of electrical parts (transistors, resistors, capacitors, etc.)
- (3) Maximum collector dissipation at the time of circuit adjustment
- (4) Ambient temperature
- (5) Variations in input signal
- (6) Application of abnormal pulse

4. RELIABILITY

Electronics, in recent years, has been rapidly advanced into both industrial and commercial electric equipment fields and semiconductor devices occupy a major part of such apparatus. At the same time the requirements for electronics equipment has grown and diversified.

The highest priority must be given to product reliability and design and close attention paid to manufacturing processes. It is also important to achieve high performance and reliability of semiconductor devices in products under various environmental conditions.

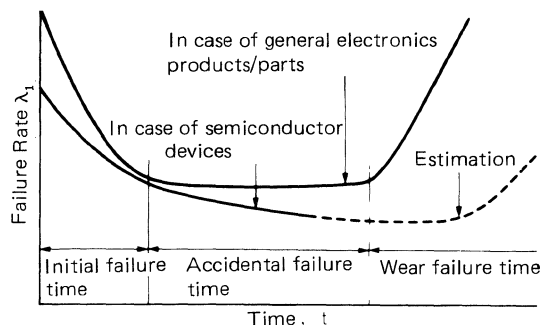
This Chapter describes what reliability is and the reliability guarantee system of Sanyo Electric's semiconductor devices.

4.1 Definition of Reliability

The reliability of semiconductor devices is generally considered as use satisfaction, but this is a fairly subjective definition. More concretely, quantitatively, and objectively, it is better defined as the probability of performance capabilities expected of the devices under certain use and environmental conditions, in which the reliability is represented as a mathematical expression of probability.

The failure of electronics products is usually described with bathtub curves as shown in Fig. 4.1. When analyzing such distribution curves, it is convenient to approximate the failure distribution to the nearest distribution function. For example, these functions are often used in analysis:

- (1) Normal distribution function
- (2) Logarithmic normal distribution function
- (3) Exponential distribution function
- (4) Weibel distribution function



[Fig. 4.1] Failure Rate Curves of Electronics Products/Parts and Semiconductor Devices

(1) and (2) are used for wear failure time, (3) for accidental failure time, and (4) for any of initial, accidental or wear failure time.

4.2 Scales of Reliability

The following scales are used in general to express reliability:

$N(t_0)$ Number of samples

$N(t)$ Number of samples maintaining expected performance after t hours.

$r(t)$ Number of failures after t hours.

- (1) Survival rate (Reliability function) $R(t)$

$$R(t) = \frac{N(t)}{N(t_0)} = \frac{N(t_0) - N(t)}{N(t_0)} = 1 - R(t) \dots\dots\dots (1)$$

- (2) Cumulative failure rate (Life distribution function) $F(t)$

$$F(t) = \frac{N(t)}{N(t_0)} = \frac{N(t_0) - N(t)}{N(t_0)} = 1 - R(t) \dots\dots\dots (2)$$

- (3) Failure generation rate (Failure density function) $f(t)$

$$f(t) = \frac{1}{N(t_0)} \times \frac{dr(t)}{dt} = \frac{dF(t)}{dt} = \frac{dR(t)}{d(t)} \dots\dots\dots (3)$$

- (4) Instantaneous failure rate $\lambda(t)$

$$\lambda(t) = \frac{1}{N(t)} \times \frac{dr(t)}{dt} = \frac{f(t)}{R(t)} = \frac{d \ln R(t)}{dt} \dots\dots\dots (4)$$

Thus, it is possible to express functions (1), (2) and (3) as those of $\lambda(t)$:

$$R(t) = \exp \left[-\int_0^t \lambda(t) dt \right] \dots\dots\dots (5)$$

$$F(t) = 1 - \exp \left[-\int_0^t \lambda(t) dt \right] \dots\dots\dots (6)$$

$$f(t) = \lambda(t) \times R(t) = \lambda(t) \exp \left[-\int_0^t \lambda(t) dt \right] \dots\dots\dots (7)$$

- (5) Average life μ

Suppose lives of samples are $t_1, t_2, \dots\dots$

$$\mu = \frac{\sum_{i=1}^N t_i}{N(t_0)} = \int_0^\infty t f(t) dt \dots\dots\dots (8)$$

Mean time between failures (MTBF) can also be represented with the same equation, which is in turn used to replace the defective part.

Neither instantaneous failure rate ($\lambda(t)$) nor average life (μ) is easy to estimate using test results or actual data. Usually the following reliability index is used for estimation:

(6) Reliability index Ri

$$Ri = \frac{N(t)}{N(t_0)Xt} \dots\dots\dots (9)$$

This is generally represented with unit of %/1,000 h, but sometimes

Fit (Failure Unit)= 10⁻⁹/h is used.

4.3 Weibel Probability Paper

Electric bulbs are known to be represented with an exponential relation

$$R(t)=\exp (-t/t_L)$$

where, R(t) is survival rate without failures versus time and t_L the average life of bulbs. However, this relationship is not always applicable to transistors. R(t) is then given by the following equation, and this R(t) is called the "Weibel function". m in these equations is determined from experimental data. The exponential function mentioned above is therefore given only when m=1.

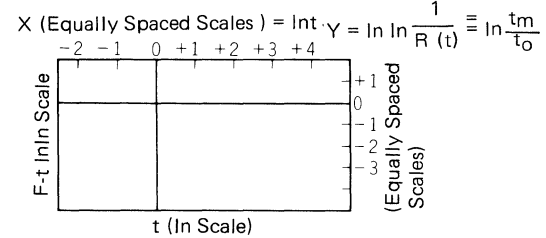
$$R(t)=\exp (-t^m/t_o^m) \text{ (Reliability function)} \dots\dots\dots (10)$$

$$F(t)=1-R(t) \text{ (Cumulative distribution function)} \dots\dots\dots (11)$$

$$f(t)=m\frac{t^{m-1}}{t_o^m} \exp (-t^m/t_o^m) \text{ (Probability density function)} \dots\dots\dots (12)$$

$$\lambda(t)=\frac{f(t)}{R(t)}=m\frac{t^{m-1}}{t_o^m} \text{ (Instantaneous failure rate)} \dots\dots\dots (13)$$

where, t_o : scale parameter
m : model parameter



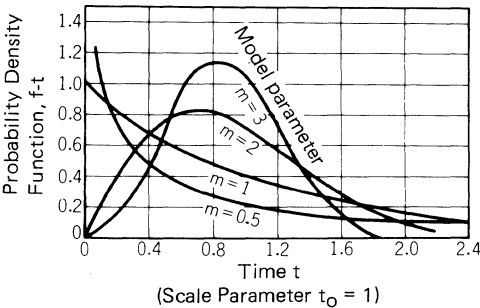
[Fig. 4.2] Weibel Probability Paper

Failure distribution of semiconductor elements are plotted using the Weibel function. Weibel probability paper is useful for the plotting. Fig. 4.2 illustrates the structure of the Weibel paper.

Cumulative failure rate F(t) is entered on the probability paper as a function of time t. And by reading the chart, model parameter m and scale parameter t_o are estimated.

In the chart shown in Fig. 4.2, slope between X=Int and Y=[ln ln 1/R(t)] is m, and ln ln 1/R(t) gives ln (1/t_o) where the curve cuts the Y-axis (ln t=0), whereby, t_o is found.

m is an important parameter in the Weibel distribution. Meaning of the values of m and the actual effects are described below.



[Fig. 4.3] Variation of Probability Density Function with Model Parameter

(1) Meaning of m values

- i) M<1 Failure rate decreases with time (initial failure).
- ii) m=1 Failure rate is constant regardless of time (accidental failure).
- iii) m>1 Failure rate increases with time (wear failure).

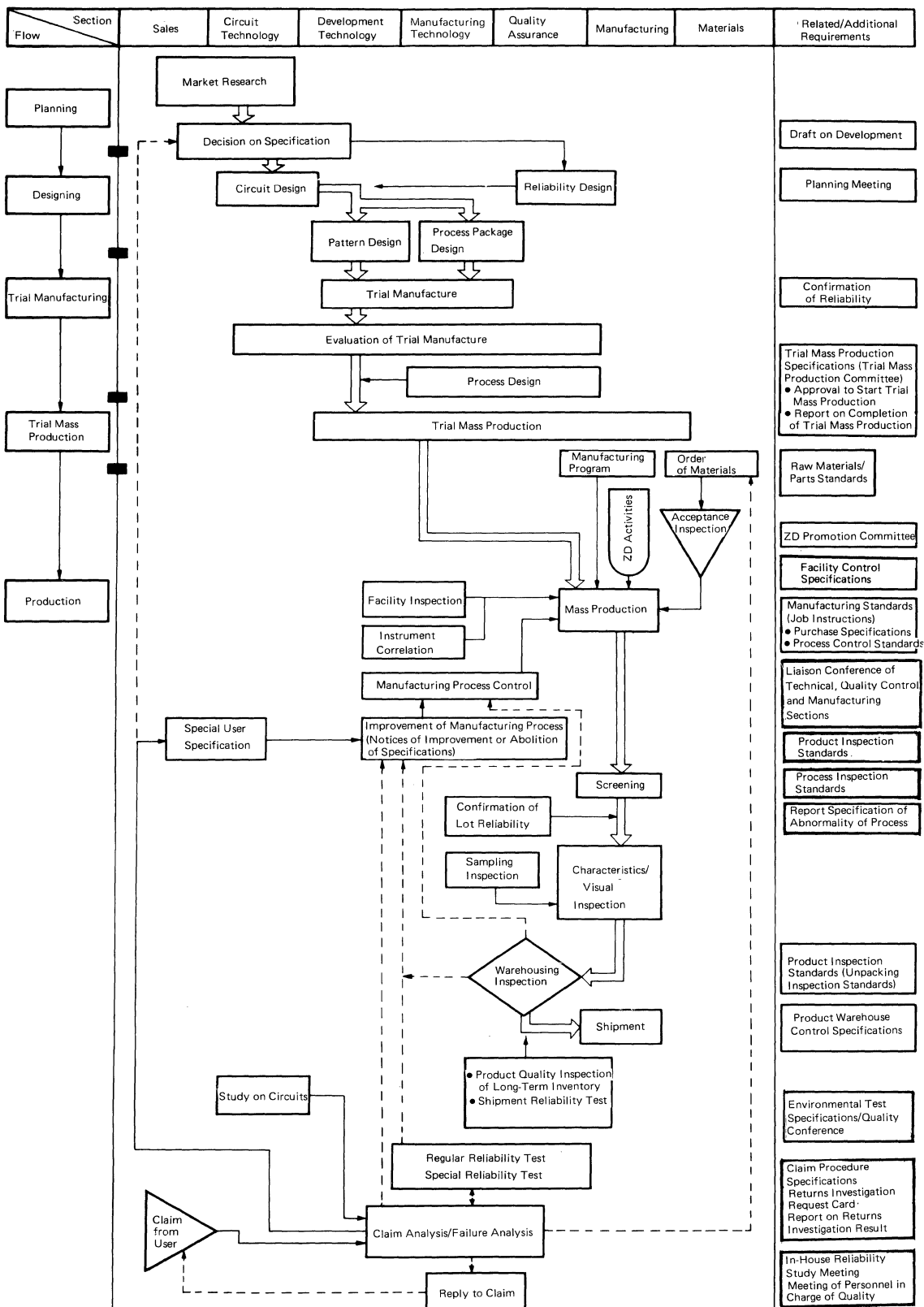
See Fig. 4.3 for actual curves.

(2) When m in the chart on the Weibel probability paper changes midway it is assumed that the failure mechanism changes at that point. This suggests that it is important in the accelerated life test not to change the m condition in acceleration or non-acceleration state.

(3) Acceleration coefficient is defined as the proportion of instantaneous failure rate. Assuming $\lambda(t)$ in equation (4) is a function of T_j, given

$$\lambda(t, T_j)=m(T_j)\frac{t^m(T_j)^{-1}}{t_o(T_j)} \dots\dots\dots (14)$$

Then, acceleration coefficient $\rho(T_{j1}, T_{j2})$



[fig. 4.4]

concerning the joint temperature can be expressed by means of relation

$$\rho(T_{j1}, T_{j2}) = \frac{\lambda(t, T_{j2})}{\lambda(t, T_{j1})} = \frac{t_o(T_{j1})m(T_{j2})t^{m(T_{j2})-1}}{t_o(T_{j2})m(T_{j1})t^{m(T_{j1})-1}} \dots\dots\dots (15)$$

If $m(T_{j1})=m(T_{j2})$ in the above two terms, then

$$\rho(T_{j1}, T_{j2}) = \frac{t_o(T_{j1})}{t_o(T_{j2})} \dots\dots\dots (16)$$

Thus, the acceleration coefficient can be found from the Weibel probability paper.

(4) Mean time between failures (MTBF)

MTBF can be found from t_o and m :

$$MTBF = t_o \frac{1}{m} \Gamma(1 + \frac{1}{m}) \dots\dots\dots (17)$$

(5) Failure rate of semiconductor devices tends to gradually decrease over thousands h with m changing in the order of 0.5 to 0.7 as far as there is no special stress applied.

4.4 Quality Assurance System

As electronics products become larger and of higher density, the demands for high quality and reliability of semiconductor devices, used in such equipment, are increasing. To satisfy these user demands, Sanyo Electric pays close attention to market research, determination of user's requirements, product quality and reliability in development, design, and mass-production planning of semiconductor devices. At the same time, the selection of raw materials and parts is thoroughly discussed and evaluated from various aspects in terms of reliability. Standards for mass-production are determined after completely confirming the correctness of materials and parts.

At the mass production stage, every kind of control is used to maintain the quality intended for the design stage.

Particularly, stress is laid on product quality control through acceptance of raw materials and parts, the full manufacturing process, and final product inspection so that the final products meet the user's need.

Sample inspection and reliability tests are also conducted at the shipping stage to insure the quality and reliability of all products. Information

on the quality and reliability is most important to guarantee our semiconductor products after shipment, particularly for investigation of claimed defects by users or from the market place.

Sanyo Electric's quality assurance system as stated above is illustrated in Fig. 4.4.

4.5 Methods of Reliability Tests

As mentioned in the previous sections, Sanyo Electric uses an integrated product control system from designing and manufacturing processes to shipment and follow-up services to maintain the high quality and reliability of our semiconductor devices.

Test methods to confirm the reliability are described in this section. The methods are determined mainly observing JIS, JIS original form of EIAJ, MIL-STD, IEC, British Standard, and CECC, etc., and tests are conducted by laying particular stress in accelerated life testing at the maximum ratings.

(1) JIS (Japanese Industrial Standard)	
JIS-C-7030	Testing Methods for Transistors
JIS-C-7031	Testing Methods for Small Signal Diodes
JIS-C-5022	Dry Heating Testing Method for Electronic Components
JIS-C-5023	Damp Heat (Steady State) Testing Method for Electronic Components
JIS-C-5025	Vibration Testing Method for Electronic Components
JIS-C-5028	Salt Mist Testing Method for Electronic Components
JIS-C-5031	Sealing Testing Methods for Electronic Components
JIS-C-5035	Testing Method of Terminal Strength for Electronic Components
JIS-C-5036	Endurance (Electrical) Testing Method for Electronic Components
JIS-C-5003	General Test Procedure of Failure Rate for Electronic Components
JIS-C-5030	Change of Temperature Testing Method for Electronic Components
JIS-C-5021	Cold Testing Method for Electronic Components
JIS-C-5027	Storage (Low Temperature) Testing Method for Electronic Components
JIS-C-5020	General Rules for Environmental Testing Method for Electronic Components
JIS-C-7020	Environmental Testing Methods

	and Endurance Testing Methods for Discrete Semiconductor Devices
JIS-C-7021	Environmental Testing Methods and Endurance Testing Methods for Discrete Semiconductor Devices
JIS-Z-2371	Methods of Brine Spraying Test

(2) EIAJ Standard

EIAJ SD-31	Testing Methods for Field-Effect Transistors
EIAJ SD-41	Testing Methods for Rectifier Diodes
EIAJ SD-51	Testing Methods for Small Signal Diodes
EIAJ SD-71	Testing Methods for Transistors
EIAJ IC-121	Test Methods for Reliability of Integrated Circuits

(3) MIL Standard

MIL-STD-750B	Test Methods for Semiconductor Devices
MIL-STD-202E	Test Methods for Electronics and Electric Component Parts
MIL-STD-883B	Test Methods and Procedures for Microelectronics

(4) IEC Standard

Publication 68	Basic Environmental Testing Procedures for Electronic Components and Electronic Equipment
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(5) British Standard

BS9400	Specification for Integrated Electronic Circuits of Assessed Quality: Generic Data and Methods of Test.
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(6) CECC Standard

CECC 50000	Generic Specification: Discrete Semiconductor Devices.
CECC 90000	Generic Specification: Monolithic Integrated Circuits.

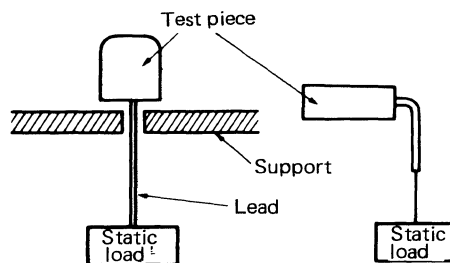
4.5.1 Mechanical tests

(1) Lead pull test

Hold the test piece as shown in Fig. 4.5 and apply a specified static load (shown below) in the axial direction of each lead for a specified period of time to check if the lead falls off.

(Transistor, diode)

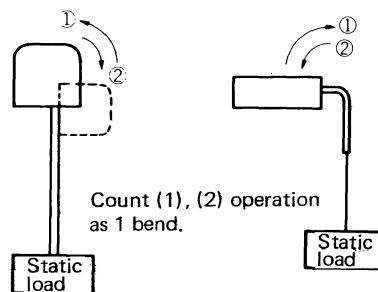
Nominal Cross-Sectional Area (mm ²)	Nominal Lead Diameter (mm)	Load (kg)	Holding Time (sec.)
0.07 to less than 0.2	0.3 to 0.5	0.5	10 ± 1
0.2 to less than 0.5	0.5 to 0.8	1.0	10 ± 1
0.5 to less than 1.0	0.8 to 1.2	2.5	10 ± 1
1.0 or more	More than 1.2	4.5	10 ± 1



[Fig. 4.5]

(2) Lead bend test

Hold the test piece as shown in Fig. 4.6 and apply a specified static load (1/2 of load shown above) in the axial direction of each lead and rotate the body 90° and return it to normal. Take approximately 5 seconds in doing this operation and count this as 1 bend. Next, rotate the body 90° in the reverse direction at the same speed and return it again to normal. Count this also as 1 bend. After making 2 bends, check if the lead falls off. Each lead must be bent in the same direction on the same plane each time.



[Fig. 4.6]

(3) Drop test

Drop the test piece, under its own weight, 3 times from a height of 75cm onto a horizontally placed wooden board (maple board, 3cm (thick) x 30 x 30cm) in such a way as it does not strike the board with the leads. Then, check the specified items.

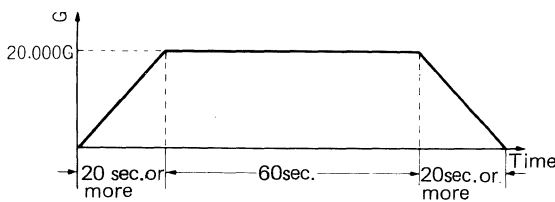
(4) Vibration fatigue test

Fix the test piece on the vibration table of a vibration tester so that vibration is completely transmitted to the test piece. Make vibration under the following conditions. Then, check the specified items.

Vibration Description	Frequency Variation
Frequency range	10 to 500Hz (or 2000Hz)
Total amplitude or acceleration	1.5mm or 20G
Sweep rate	10 to 500 to 10Hz, approx. 15min.
Sweep frequency variation	Logarithmic
Test time (total)	2hr. each for X, Y, Z

(5) Centrifugal acceleration test

Fix the test piece on the mount table of a centrifugal acceleration tester firmly and apply an acceleration of 20,000G (G: Acceleration of gravity 9.8m/sec.^2) in 3 directions (X, Y, Z meeting at right angles to each other) for 60 seconds respectively. Then, check the specified items. It is necessary to take 20 seconds or more in operating acceleration and deceleration respectively.



[Fig. 4.7]

(6) Impact test

Using a proper device, fix the test piece on an impact tester firmly so that impact is completely transmitted to the test piece and apply an impact of 1,500G 3 times (diode: 5 times) in 3 directions (X, Y, Z meeting at right angles to each other) respectively. Then, check the specified items.

4.5.2 Environmental Test

(1) Resistance to soldering heat test

Without applying any flux, dip all leads of the test piece to a specified length of the body in solder (Sn 60% + Pb 40%) for 10 ± 1 seconds at a solder temperature of $260 \pm 5^\circ\text{C}$ and remove the leads from solder and allow to stand for 1 hour or more. Then, check the specified items.

[Table 4.1]

	Silicon Transistor	Germanium Silicon Diode
Specified Length	1.0 to 1.5mm	5mm

(2) Solderability test

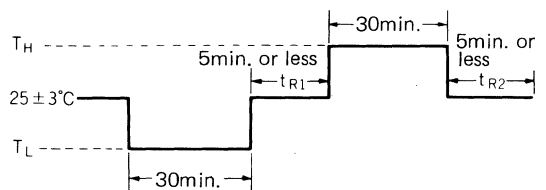
With flux of rosin series applied to all leads, dip all leads of the test piece to a specified length of the body in solder (Sn 60% + Pb 40%) for 5 ± 0.5 seconds at a solder temperature of $230 \pm 5^\circ\text{C}$ and remove the leads from solder and allow to stand. Then, check the specified items.

If any structural restriction makes it impossible for all leads to be dipped simultaneously, dip the leads in turn.

(3) Temperature cycle test

Put the test piece alternately in a low constant temperature bath and high constant temperature bath which are set at a specified temperature. Start this operation with the low constant temperature bath. The period of time for the test piece to be dipped in the respective baths should be long enough for the test piece to reach thermal equilibrium state. After completion of 5 cycles, allow to stand at room temperature for 2 hours or more. Then, check the specified items.

T_H and T_L represent the highest and lowest storage temperatures of absolute maximum rating T_{stg} respectively.



[Fig. 4.8]

(4) Salt spray test (Corrosion-resistance test)

Spray salt water to the test piece for 24 ± 2 hours and rinse it fully in water at normal temperature. Then, check the specified items. The salt spray conditions are as follows:

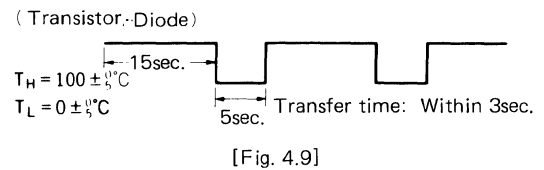
Condition 1. Salt water concentration: $5 \pm 1\%$
Internal temperature of test bath: $35 \pm 2^\circ\text{C}$

Condition 2. Salt water spray rate: Salt precipitates in the prescribed quantity ($10,000$ to $50,000\text{mg/m}^2$ /

day) when salt water of $5 \pm 1\%$ is sprayed.

(5) Thermal impact test

Dip the test piece alternately in a low temperature liquid (ice and water) and a high temperature liquid (boiled water). Start this operation with the high temperature liquid. The period of time for the test piece to be dipped in the respective liquids shall be as shown in Fig. 4.9. After completion of 5 cycles, allow to stand at room temperature for 16 hours or more. Then, check the specified items.



(6) Leak test

Place the test piece in a helium gas container whose pressure is kept at $5\text{kg}/\text{cm}^2$ and subject the test piece to this pressure for 5 ± 1 hours. Remove the test piece from the pressure container and spray clean air to it in order to blow off helium gas attached to the test piece. Then, check the presence or absence of leak using a helium tester.

4.5.3 Life Test

(1) High temperature, high humidity storage life test

Store the test piece for a specified period of time at a specified temperature and a relative humidity of $90 \pm \frac{5}{10}\%$ and allow to stand for the specified period of time (1,000 hours) at room temperature. Then, check the specified items.

[Table 4.2]

	Transistor • Diode
Temperature	$60 \pm 3^{\circ}\text{C}$ (or $40 \pm 2^{\circ}\text{C}$)
Time	16 hours

(2) High temperature storage life test

Store the test piece for the specified period of time (1,000 hours) at the highest storage temperature T_H of the absolute maximum rating and allow to stand for 16 hours or more at room temperature. Then, check the specified items.

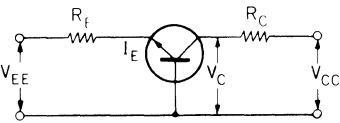
(3) Low temperature storage life test

Store the test piece for the specified period of time (1,000 hours) at the lowest storage tempera-

ture T_L of the absolute maximum rating and allow to stand for 16 hours or more. Then, check the specified items.

(4) Transistor operation life test

Set V_C and I_E so that P_C of the test piece becomes as specified at $T_a = 25 \pm 3^{\circ}\text{C}$ and operate it for 1,000 hours. After completion of the operation, allow to stand for 16 hours or more. Then, check the specified items. The common-base circuit is used for this test.



[Fig. 4.10]

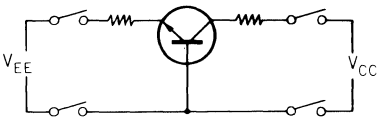
Collector voltage (V_C): 40 to 60% of V_{CEOmax} .
Emitter current (I_E): Current at which P_{Cmax} or T_{jmax} occurs at the above collector voltage (V_C)

(5) Intermittent operation life test

Using the specified circuit shown below, operate the test piece 5,000 times. After completion of the operation, allow to stand for 16 hours or more at room temperature. Then, check the specified items.

[Table 4.3]

	ON/OFF Time	Condition
Transistor	2min. / 3min.	Same as in (4) Transistor operation life test

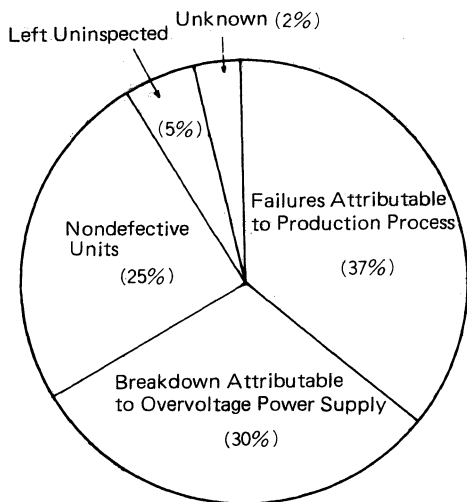


[Fig. 4.11]

4.6 Failure Factors and Derating

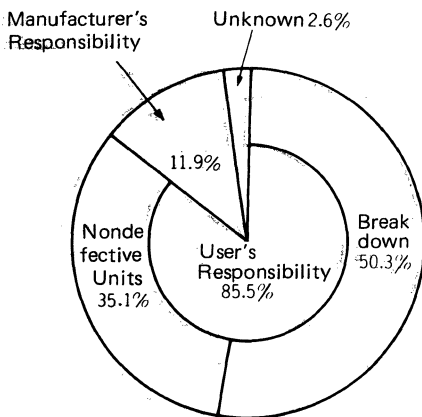
Failures of semiconductor devices are caused by defects of devices themselves or operating or environmental conditions.

Fig. 4.11 shows an example of classified failure modes of defective semiconductor devices found in the field. As clearly seen from this example, a considerable ratio of the failures is caused at the design or use stage.



[Fig. 4.11] Transistor Failure Modes in the Field

Fig. 4.12 shows an example of classified failure modes of defective semiconductor devices found by users.



[Fig. 4.12] Transistor Failure Modes Found by Users

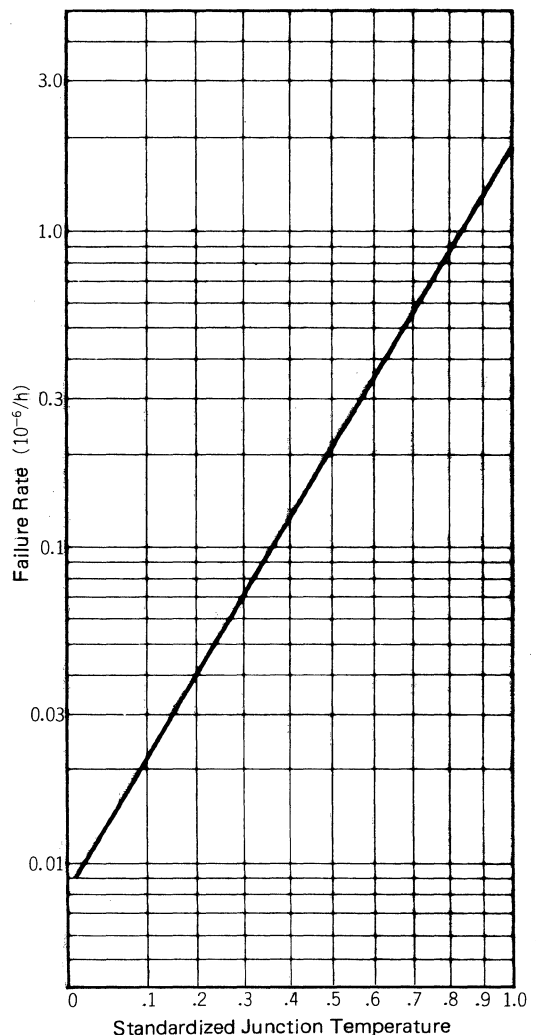
Information on classification, analysis of product defects and causes of failures is fed back to each department of development, design, production, and sales so that our semiconductor devices can be used by our customers satisfactorily.

The following is a description of derating.

Derating (load reduction) is a practice where electrical or mechanical stresses which a device is capable of withstanding is reduced to be a little less than the maximum rating so that the expected life of a device could be lengthened and the failure rate could be minimized. Stresses include voltage, current, junction temperature, collector dissipation and mechanical stresses include vibration, impact, pull, etc.

For derating of voltage, current, refer to 3. MAXIMUM RATINGS; and for derating of junction temperature, refer to 5. THERMAL DESIGN OF SEMICONDUCTOR CIRCUIT. When using a semiconductor device, its junction temperature should be as low as possible.

Fig. 4.13 shows typical example of failure rate vs. junction temperature for plastic molded transistors.



[Fig. 4.13]

4.7 Conclusion

The above is a general description of quality and reliability concerning our semiconductor devices. In order to provide higher reliability in actual applications, it is necessary to thoroughly grasp the property of semiconductor devices and to fully consider operating and environmental conditions.

Much more things are yet to be done to provide higher reliability. Use of semiconductor devices should be determined after checking their quality, reliability, and economy.

When you apply semiconductor devices in your equipment, please contact us. We will surely be able to offer you our semiconductor devices that meet your requirements.

5. THERMAL DESIGN OF SEMICONDUCTOR CIRCUIT

5.1 General Description

As described in 3. MAXIMUM RATINGS, characteristics of transistors greatly depend on temperature. If the maximum allowable junction temperature is exceeded, transistors may deteriorate or break down. Thermal design of transistor circuits must be made very carefully not only to cause no momentary breakdown but also to provide longer service life and greater reliability.

5.2 Collector Dissipation and Junction Temperature

Collector dissipation P_C is related to junction temperature T_j as follows:

$$T_j = P_C \theta + T_o$$

where θ : Thermal resistance ($^{\circ}\text{C}/\text{W}$) of transistor which represents the rate of T_j rise when unit P_C occurs and is specified for each Type No. of transistor.

T_o : Reference temperature for which ambient temperature T_a or case temperature T_c is used. T_o is normally 25°C .

This equation can be rewritten as $P_C = (T_j - T_o)/\theta$. It is seen from this equation that maximum collector dissipation $P_C \text{ max}$ that can be applied to a transistor is limited by:

$$P_C \text{ max} = (T_j \text{ max} - T_c)/\theta$$

where $T_j \text{ max}$: Maximum allowable junction temperature

However, this equation holds only when thermal stability of a circuit is ideally satisfactory as in case of dual-supply common base mode. In ordinary applications collector dissipation P_C must not exceed $P_C \text{ max}$.

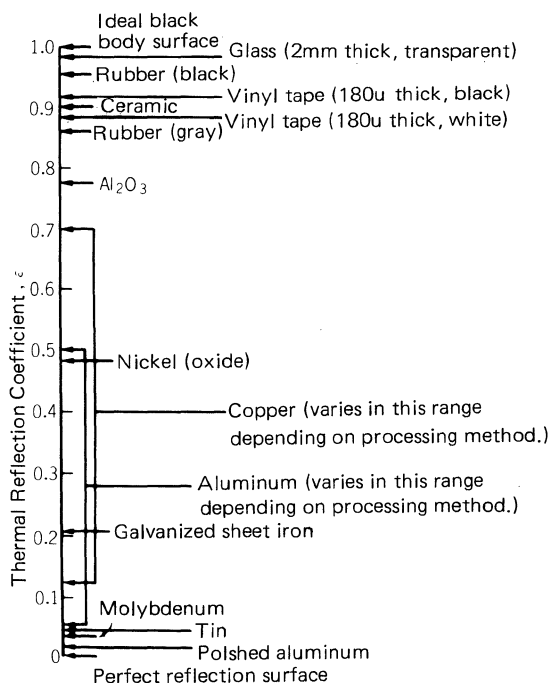
5.3 Thermal Resistance of Transistor

More collector dissipation than limited causes self-heat generation to occur, making the temperature of a transistor higher than ambient temperature. Radiation, convection, and conduction can be used to remove heat generated in a transistor. The thermal resistance of a transistor depends

on the multiplication effect of radiation, convection, and conduction. The specification for each Type No. of transistor specify no thermal resistance, but it can be calculated from $\theta = (T_j \text{ max} - T_o)/P_C$ by using $P_C \text{ max}$ and $T_j \text{ max}$ specified on the specification for each Type No. of transistor. Strictly speaking, thermal resistance also depends on temperature and applied voltage, etc., but dependence of thermal resistance on temperature and applied voltage can be covered by this equation.

When selecting a heat sink, Fig. 5.1 for thermal radiation and Table 5.1 for thermal conduction can be conveniently used.

Thermal resistance, being a quantity in thermodynamic system, can be easily understood by electrical analogy as shown in Table 5.2. Thermal capacity is dominant at a thermally transient state where collector dissipation occurs, but resistance only exists at a thermally steady state. Fig. 5.2 shows the equivalent circuit of thermal resistance of transistors. Total thermal resistance θ_{ja} from junction to atmosphere is given by equation (1).



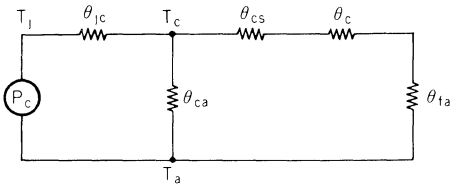
[Fig. 5.1] Thermal Radiation Coefficient of Various Materials

[Table 5.1] Thermal Conductivity λ of Various Materials at 0°C

Material	$\lambda(\text{W/m}^\circ\text{C}) \times 10^{-3}$	Material	$\lambda(\text{W/m}^\circ\text{C})$
Ag	4.10	Bakelite	0.0023
Cu	3.80		
Al	2.04	Epoxy (without filler)	0.0017
Ni	0.92		
Fe	0.75		
Alumina	0.17		
Beryllia	1.18		

[Table 5.2] Relation between Thermodynamic System and Electrical System

Thermodynamic System		Electrical System	
Quantity of heat (power dissipation)	P	Current	I
Temperature	T	Voltage	V
Thermal resistance	θ	Resistance	R
Thermal capacity	C	Capacity	C
Thermal time constant	τ	Time constant	τ



- θ_{jc} : Junction to case thermal resistance
- θ_{cs} : Case to insulating sheet thermal resistance
- θ_c : Contact thermal resistance at heat sink and contact part
- θ_{fa} : Heat sink to atmosphere thermal resistance
- θ_{ca} : Case to atmosphere thermal resistance

[Fig. 5.2] Equivalent Circuit of Thermal Resistance of Transistors

$$\theta_{ja} = \theta_{jc} + \frac{\theta_{ca}(\theta_{cs} + \theta_c + \theta_{fa})}{\theta_{ca} + \theta_{cs} + \theta_c + \theta_{fa}} \dots \dots \dots (1)$$

For low-power transistors with no heat sink mounted, $\theta_{ja} \doteq \theta_{jc} + \theta_{ca}$ applies; and for high-power transistors with a heat sink mounted, equa-

tion (2) applies.

$$\theta_{ja} \doteq \theta_{jc} + \theta_{cs} + \theta_c + \theta_{fa} \dots \dots \dots (2)$$

Each thermal resistance is explained below.

(1) θ_{jc}

Junction to case thermal resistance which depends on various factors such as chip structure, area, chip-to-stem weld material, and case material.

For high-power transistors, the specification for each Type No. of transistor specifies $P_{C \text{ max}}$ at $T_c = 25^\circ\text{C}$ and θ_{jc} is obtained from $\theta_{jc} = (T_{j \text{ max}} - T_c)/P_{C \text{ max}}$.

(2) θ_s

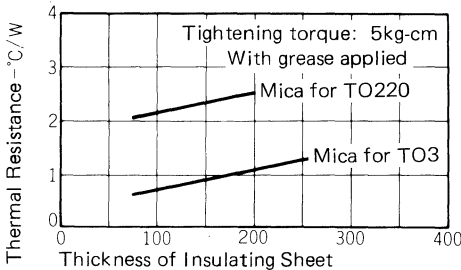
Thermal resistance of insulating sheet which depends on insulating sheet material, thickness, size. Insulating sheet materials include mica, polyester, and silicone rubber. Mica is most generally used on account of its thermal conduction. Table 5.4 shows the thermal resistance of mica used by us.

[Table 5.4] Thermal Resistance of Mica

Kind	Use	Thermal Resistance ($\theta_s + \theta_c$)
3M	TO-3	0.4 ~ 0.7°C/W
66MT	TO-66	0.6 ~ 0.8 "
313	TO-220	1.8 ~ 2.2 "
IS - 126	TO-126	4 ~ 5 "

With silicone grease applied
Tightening torque: 5kg-cm

High-voltage transistors packaged in the TO-3 package often use a thick mica. It should be noted that thermal resistance increases with increasing thickness of mica as shown in Fig. 5.3.

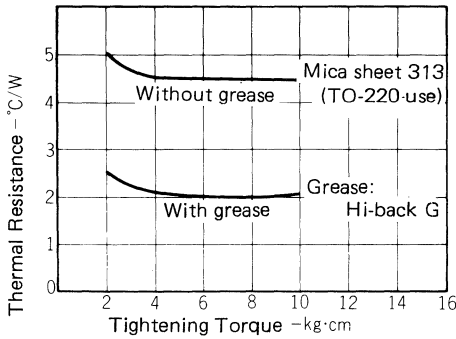


[Fig. 5.3] Thickness of Insulating Sheet and Thermal Resistance

(3) θ_c

Case to insulating sheet, insulating sheet to heat sink contact thermal resistance which depends on roughness of case heat sink surface, contact area, and tightening torque. Fig. 5.4 shows the relation between tightening torque and $(\theta_s + \theta_c)$. A torque of 4kg-cm or greater causes almost no change in thermal resistance. A torque more than needed may bend the transistor case.

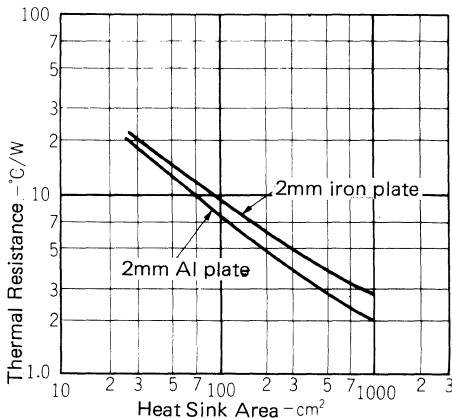
Application of silicone grease reduces contact thermal resistance. It should be noted that molded type transistors may be affected by application of grease.



[Fig. 5.4] Tightening Torque and Thermal Resistance

(4) θ_{fa}

Thermal resistance of heat sink which, strictly speaking, depends on heat sink surface area, heat sink thermal conductivity, radiation efficiency, etc. It is difficult to calculate θ_{fa} , but its rule-of-thumb value can be obtained from Fig. 5.5 (Heat Sink Area and Thermal Resistance).



[Fig. 5.5] Heat Sink Area and Thermal Resistance

(5) Example of calculation

A concrete example of thermal design is given below.

The heat sink area is obtained which is required to operate high-power transistor 2SD313 at power dissipation $P_C = 5W$, ambient temperature $60^\circ C$. The specification for the 2SD313 specifies $P_{C\max} = 30W$, $T_{j\max} = 150^\circ C$. Therefore, $\theta_{jc} = (150^\circ C - 25^\circ C)/30W = 4.2^\circ C/W$

If derating is provided to limit T_j to $110^\circ C$, junction-to-atmosphere thermal resistance θ_{ja} becomes as follows: $\theta_{ja} = (110^\circ C - 60^\circ C)/5W = 10^\circ C/W$

When a 0.075mm thick mica sheet, as insulating sheet, with silicone grease applied is mounted on the heat sink by applying 5kg-cm torque, $\theta_s + \theta_c = 2.0^\circ C/W$ is obtained from Fig. 5.4 and $\theta_{fa} = \theta_{ja} - (\theta_{jc} + \theta_s + \theta_c) = 10^\circ C/W - (4.2^\circ C/W + 2.0^\circ C/W) = 3.8^\circ C/W$ is obtained from equation (2).

It is seen from Fig. 5.5 that the heat sink area required is $300cm^2$ (2mm thick Al plate).

5.4 Thermal Stability of Circuit

Care must be exercised when making the thermal design of a transistor circuit under $P_{C\max} = (T_{j\max} - T_o)/\theta_{ja}$, because this equation holds, as mentioned above, only at a state where thermal stability of a circuit is ideal. If the circuit is not thermally stable, thermal runaway occurs through repetition of the following three processes.

(1) T_j varies by ΔT_{j1} for some reason or other, which causes collector current I_C to increase by ΔI_{C1} .

(2) ΔI_{C2} causes P_C to increase by ΔP_{C2} .

(3) ΔP_{C3} causes T_j to increase by ΔT_{j3} .

If the loop gain exceeds 1, thermal runaway occurs.

Let S be defined as follows:

$$\frac{\Delta I_{C1}}{\Delta T_{j1}} \cdot \frac{\Delta P_{C2}}{\Delta I_{C2}} \cdot \frac{\Delta T_{j3}}{\Delta P_{C3}} \equiv S \dots\dots\dots (3)$$

$S < 1$ and $S \geq 1$ provide stability and instability respectively. S is called the thermal stability of a bias circuit.

Fig. 5.6 (a) shows a general bias circuit. This circuit is converted into the circuit in Fig. 5.6 (b) for the convenience of calculation. The new circuit constants and the old ones are related to each other by the following equations.

$$\left. \begin{aligned} R_E &= R_3 + \frac{R_1 + (R_6 + R_7)}{R_1 + R_2 + R_6 + R_7} \\ R_C &= R_4 + \frac{R_2 (R_6 + R_7)}{R_1 + R_2 + R_6 + R_7} \\ R_B &= R_5 + \frac{R_2 \cdot R_2}{R_1 + R_2 + R_6 + R_7} \\ V_{BB}' &= \frac{R_1}{R_1 + R_2 + R_6 + R_7} \cdot V_{CC} \\ V_{CC}' &= \frac{R_1 + R_2}{R_1 + R_2 + R_6 + R_7} \cdot V_{CC} \end{aligned} \right\} \dots \dots \dots (4)$$

In this case, stability factor S is expressed as follows:

$$S = \left\{ S_I \left[\phi I_{CBO} + \frac{I_E}{(1 + h_{FE})^2} \cdot \frac{dh_{FE}}{dT_j} \right] + SV \frac{dV_{BE}}{dT_j} \right\} \left[V_{CC}' - 2 I_C (R_C + R_E) \right] \theta_{ja} \dots \dots \dots (5)$$

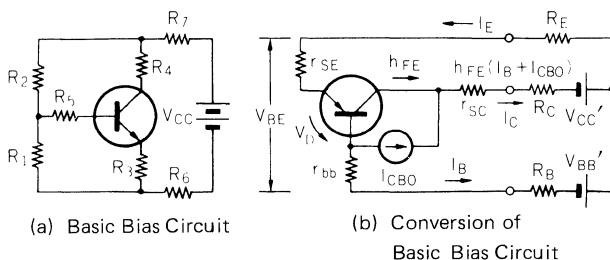
$$S_I = \frac{(1 + h_{FE}) (R_E + r_{SE} + R_B + r_{bb}')}{(1 + h_{FE}) (R_E + r_{SE}) + R_B + r_{bb}'} + \frac{h_{FE} (1 + h_{FE}) (R_B \cdot r_{SE} + R_E \cdot r_{bb}')}{[(1 + h_{FE}) (R_E + r_{SE}) + R_B + r_{bb}'] [(1 + h_{FE}) R_E + R_B]} \dots \dots \dots (6)$$

$$SV = \frac{-h_{FE}}{(1 + h_{FE})^2} \dots \dots \dots (7)$$

[Table 5.4] Insulating Sheet Thickness and Contact Thermal Resistance

Insulating Sheet	Thickness (μ)	Thermal Resistance θ_{CS} ($^{\circ}\text{C}/\text{W}$)
Without insulating sheet		0.4
Alumina	40.5	0.4
"	31.4	0.5
Mica	5.1	0.5
"	10.2	0.65
Polyester	50.0	0.6
Glass fiber	7.5	1.25
Beryllia	150.0	0.057

ϕ , being a constant representing the dependence of I_{CBO} on temperature, is approximately 0.07 to 0.08 ($1/^{\circ}\text{C}$) and 0.06 ($1/^{\circ}\text{C}$) for Ge transistors and Si transistors respectively. In general, $dV_{EB}/dT_j = -2.0$ to 2.4 ($\text{mV}/^{\circ}\text{C}$) is obtained. dh_{FE}/dT_j , which depends on bias conditions, is approximately 0.3 to 2.0 for normal collector current, voltage. This should be calculated from the dependence of h_{FE} on temperature specified on the specification for each Type No. of transistor. r_{SE} , being the emitter series bulk resistance, is approximately 0.03 to 1.0 ohm.



- r_{bb} : Base resistance
- r_{SE} : Emitter* & electrode resistance
- r_{SC} : Collector & electrode resistance
- V_{BE} : Emitter-base lead resistance
- V_D : Real emitter-base voltage of transistor

[Fig. 5.6] Basic Bias Circuit and its Conversion for Calculation of Stability

6. ASO

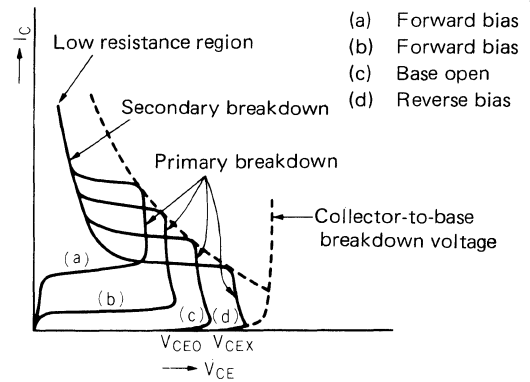
General Description

It is needless to say that external stresses to which transistors are subjected must be fully considered when making a circuit design; otherwise what is called "cold death" — transistor's instantaneous breakdown without heat generation — may result. One of the causes for this phenomenon is secondary breakdown which was introduced by C.G. Thornton and C.D. Simmons in 1958.

Secondary breakdown is an abrupt transition from a region of primary breakdown to a region of substantially lower dynamic resistance which occurs as collector voltage increases as shown in Fig. 6.1. The mechanism of this phenomenon has been studied from various points of view, but has not yet been explained satisfactorily; and the theory of thermal runaway caused by local current concentration is generally adopted to explain this phenomenon.

In the region where secondary breakdown starts, current concentration causes thermal resistance to increase abruptly and P_C which raises the junction temperature to a maximum decreases abruptly. Therefore, the region where a transistor operates safely and reliably often becomes narrower than the region which is limited by the maximum ratings of voltage, current, and power dissipation.

For this reason, ASO (Safe Operation Area or Area of Safe Operation) is specified in addition to the maximum ratings of voltage, current, and power dissipation under which normal operation of a transistor is guaranteed, that is to say, ASO is prior to the maximum ratings of voltage, current, and power dissipation.



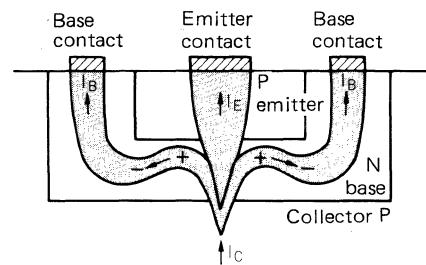
[Fig. 6.1] Secondary Breakdown

6.1 Secondary Breakdown and Transistor Structure

The following are the factors which give rise to current concentration. In designing and manufacturing transistors, these factors must be fully considered.

(1) Ununiformed base width, defective junction attributable to anomalous diffusion, ununiformed thermal diffusion attributable to way of mounting chip on heat sink.

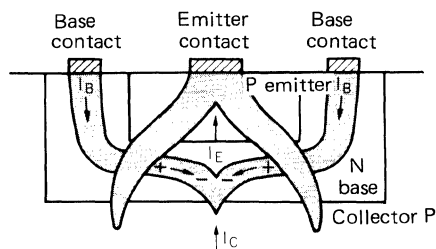
(2) Pinch-in effect or fringing effect attributable to traverse voltage drop in base region associated with transistor electrode pattern design.



(E-to-B reverse bias)

Current concentration in the center of emitter

(a) Pinch-in effect



(E-to-B reverse bias)

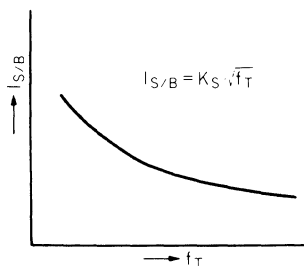
Current concentration in the vicinity of emitter

(b) Fringing effect

[Fig. 6.2] Pinch-in Effect and Fringing Effect

Secondary breakdown is related to the transistor characteristic as follows:

As fan-out effect, which depends on the diffusion design of the base width and the drift field in the base region, is more increased, current concentration is harder to occur. Therefore, f_T is negatively related to secondary breakdown current $I_{S/B}$ as shown in Fig. 6.3.



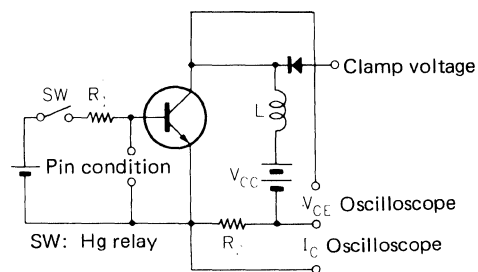
[Fig. 6.3] Relation between $I_{S/B}$ and f_T

6.2 ASO Measurement

Since secondary breakdown causes a transistor to break down, ASO measurement involves various matters to be considered. Latching method, forward bias secondary testing method, and ΔV_{BE} method are available for ASO measurement. A proper method should be chosen considering the circuit configuration, operating conditions for a transistor to be used.

(1) Latching method

Fig. 6.4 shows an example of latching method using an inductance load. A transistor is set in the saturation region, and then voltage, current at the time secondary breakdown starts are measured under specified bias conditions.

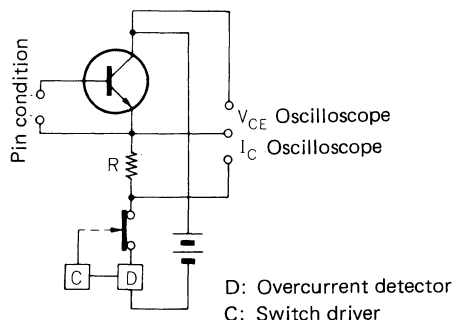


[Fig. 6.4] Latching Method Using Inductance Load

In this method, it is convenient to observe oscillation appearing on the current vs. voltage characteristic when secondary breakdown starts, and breakdown is rather hard to occur after secondary breakdown is entered.

(2) Forward bias secondary breakdown testing method

Fig. 6.5 shows an example of base drive method to apply a pulse to the base. Voltage is applied across collector and emitter and a drive pulse is applied across emitter and base so that a transition from primary breakdown to secondary breakdown occurs. A protection circuit must be provided to prevent the characteristics from worsening after secondary breakdown is completely entered.

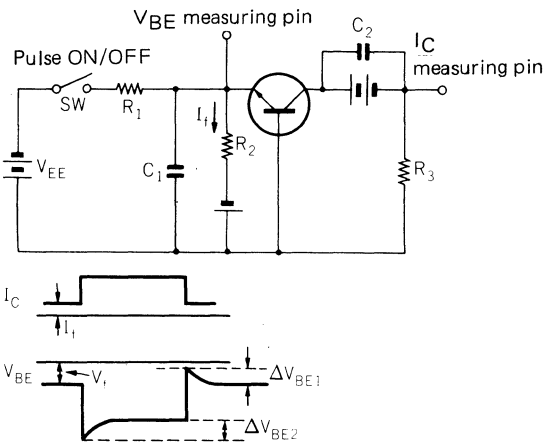


[Fig. 6.5] Forward Bias Secondary Breakdown Testing Method (Base Drive Method)

(3) Transient thermal resistance measuring method (ΔV_{BE} method)

Since secondary breakdown is considered to be local thermal runaway caused by current concentration, start of secondary breakdown is noticed by observing the junction temperature. The test circuit is shown in Fig. 6.6. The temperature coefficient of forward emitter-to-base voltage V_{BE} is measured beforehand and ΔV_{BE} before and after application of a specified power is measured. From these measurements, the junction tempera-

ture rise is found out and the transient thermal resistance is obtained.

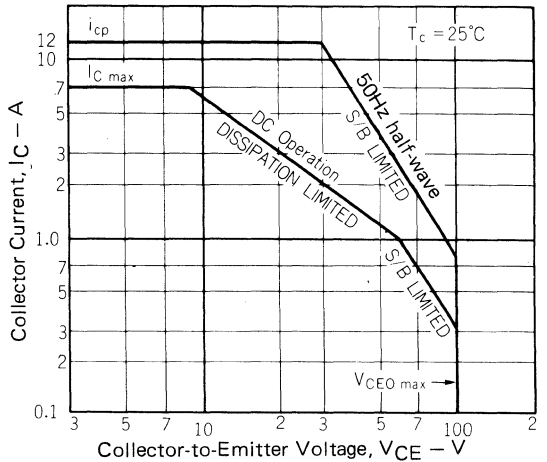


[Fig. 6.6] Transient Thermal Resistance Measuring Method (ΔV_{BE} Method)

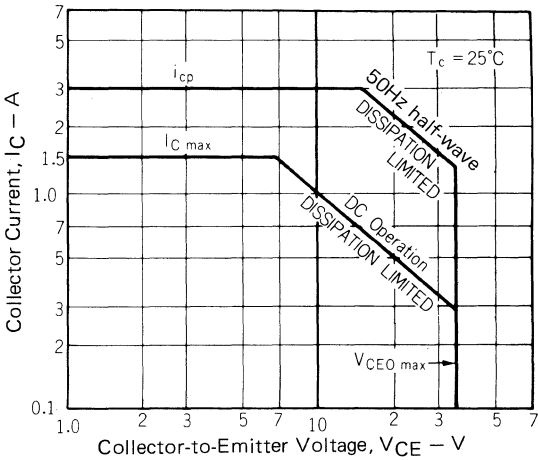
This method can be used to specify ASO at the maximum junction temperature. This method, which measures the maximum junction temperature, has an advantage in that there is little possibility of deteriorating a transistor. In this method, however, ASO is made narrower as compared with latching method, forward bias secondary breakdown testing method.

6.3 Example of ASO Measurement

ASO's shown in Figs. 6.7 and 6.8 are for power amplifier transistors 2SC1051 and 2SD325 respectively. For obtaining the dissipation limited region at $T_{j\max} = 150^{\circ}\text{C}$, steady-state thermal resistance is used for DC operation and transient thermal resistance is used for pulse operation.



[Fig. 6.7] 2SC1051 ASO

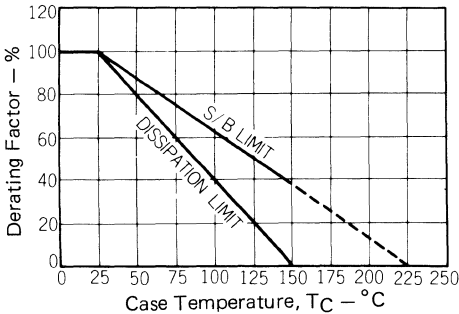


[Fig. 6.8] 2SD325 ASO

The S/B limited region is obtained by forward bias secondary breakdown testing method.

6.4 ASO Derating

ASO is normally specified for operation at a case temperature of 25°C (small signal transistor: $T_a = 25^{\circ}\text{C}$). If operated at a higher temperature than this, temperature compensation must be provided by using the derating curves shown in Fig. 6.9. ASO is obtained by multiplying a current value at $T_c = 25^{\circ}\text{C}$ by a derating factor corresponding to a specified case temperature.



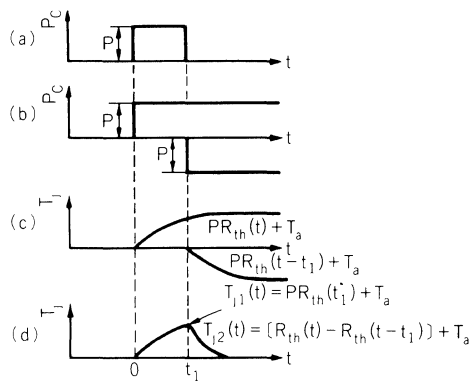
[Fig. 6.9] ASO Derating Curve

6.5 Junction Temperature for Application of Repetition Pulse

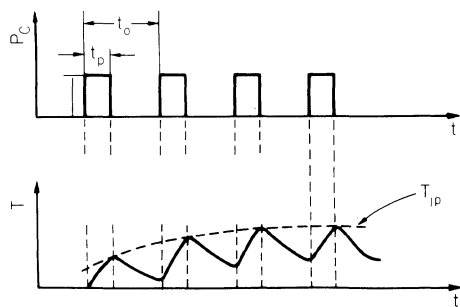
The dissipation limited region of ASO is normally specified for maximum rated junction temperature T_j . This section describes how to calculate the junction temperature when collector dissipation pulses are applied repeatedly.

In case where a collector dissipation pulse shown in Fig. 6.10 (a) is applied, the junction tem-

perature shown in Fig. 10 (d) is obtained through steps of Figs. 10 (b), (c).



[Fig. 6.10] Calculation of Junction Temperature for Application of Collector Dissipation Pulse



[Fig. 6.11] Repetition Collector Dissipation Pulse and Junction Temperature

By applying this method to the continuous square wave pulse shown in Fig. 6.11, the following relation is obtained.

$$T_{jp} = P R_{th} (t_p, D) + T_a$$

$$R_{th} (t_p, D)$$

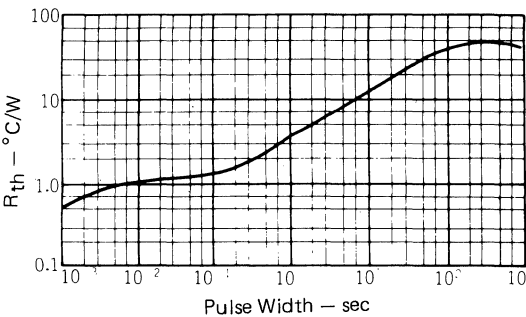
$$= D R_{th} + (1 - D) R_{th} (t_o + t_p)$$

$$- R_{th} (t_o) + R_{th} (t_p)$$

R_{th} : Steady-state thermal resistance
 $R_{th} (t)$: Transient thermal resistance

$$D = t_p / t_o$$

$R_{th} (t_o)$, $R_{th} (t_p)$, and $R_{th} (t_o + t_p)$ are given by the chart shown in Fig. 6.12.



[Fig. 6.12] 2SD313 Transient Thermal Resistance

7. HANDLING AND MOUNTING OF TRANSISTORS

7.1 Preface

Our transistors are developed and produced with full attention paid to their quality, especially to reliability. Reliability of transistors considerably depends on not only factors inherent in transistors but also circuit conditions, mounting conditions, environmental conditions, etc.

The following must be considered when selecting and using a transistor.

- (1) Maximum ratings
- (2) Derating
- (3) Thermal design on circuit
- (4) Handling and mounting
- (5) Others (storage, transportation, etc.)

This section describes handling and mounting of transistors.

7.2 Cautions for Transistor Mounting

When mounting a transistor, proper cautions must be observed in terms of its structure.

Proper cares to be taken in each of the following procedures are described below.

- (1) Lead forming, cutting
- (2) Mounting of transistor on board
- (3) Fastening of transistor to heat sink
- (4) Soldering
- (5) Others

7.2.1 Lead forming, cutting

When mounting a transistor on a printed circuit board, it may be necessary to form or cut the leads. In this case, application of excessive force could cause damage to the transistor or shorten its life.

- (1) When forming the leads, hold the lead firmly, for example, as shown in Fig. 7.1 to prevent relative movement between the lead and the case.
- (2) When bending the leads in the plane perpendicular to that of the leads, make the bend at least 3mm from the case.

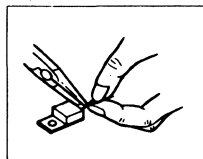


Fig. 7.1

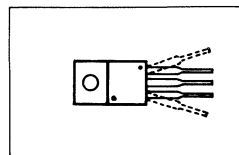


Fig. 7.2

- (3) Avoid repeated bending of the leads. Table 7.1 shows the Bend Test Method defined by JIS.
- (4) Do not bend the leads of flat type in the plane of the lead. (Refer to Fig. 7.2.)
- (5) Do not apply excessive axial pull to the leads.

JIS provides specifications according to nominal sectional areas. (Refer to Table 7.2.)

Tensile strength specified for each type of our plastic mold transistors is shown in Fig. 7.3 for your reference. The specifications in Table 7.2 must be observed to prevent transistors from deteriorating.

Table 7.1

Nominal Sectional Area (mm ²)	Nominal Lead Diameter (mm) (In case of circular section)	Load (kgf) [N]
0.07 or less	0.3 or less	0.1 [approx. 1]
more than 0.07 to 0.2 or less	more than 0.3 to 0.5 or less	0.25 [approx. 5]
more than 0.2 to 0.5 or less	more than 0.5 to 0.8 or less	0.5 [approx. 5]
more than 0.5 to 1 or less	more than 0.8 to 1.2 or less	1 [approx. 10]
more than 1	more than 1.2	1.5 [approx. 15]

Table 7.2

Nominal Sectional Area (mm ²)	Nominal Lead Diameter (mm) (In case of circular section)	Load (kgf) [N]	Hold Time(s)	
			Test Condition A	Test Condition B
0.07 or less	0.3 or less	0.3 [approx. 3]	5 ± 1	30 ± 5
more than 0.07 to 0.2 or less	more than 0.3 to 0.5 or less	0.5 [approx. 5]	5 ± 1	30 ± 5
more than 0.2 to 0.5 or less	more than 0.5 to 0.8 or less	1 [approx. 10]	5 ± 1	30 ± 5
more than 0.5 to 1 or less	more than 0.8 to 1.2 or less	2.5 [approx. 25]	5 ± 1	30 ± 5
more than 1	more than 1.2	4.5 [approx. 45]	5 ± 1	30 ± 5

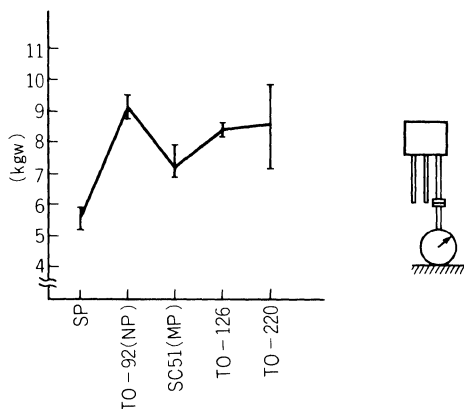


Fig. 7.3 Tensile Strength for Plastic Mold Transistor

7.2.2 Mounting of transistor on board

When mounting a transistor on a printed circuit board, do not apply excessive force to the leads for the above-mentioned reason.

- (1) Make the distance between the mounting holes the same as that between the leads.
- (2) When inserting the transistor into the board, do not pull the leads forcibly. (Refer to Fig. 7.4.)
- (3) Keep a proper distance between the board and the transistor.
- (4) Do not allow stress to be applied to the case after being fixed to the board. For example, do not fasten the transistor to a heat sink after being soldered to the board.

Fig. 7.4

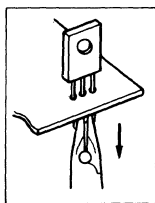


Table 7.3. Transistor Mounting Torque

Case	Optimum Mounting Torque (kg · cm)
TO-3	6 ~ 10
TO-66	4 ~ 8
TO-126	3 ~ 5
TO-220	4 ~ 7

7.2.3 Fastening of transistor to heat sink

Power transistors use a heat sink to remove heat generated internally. When fastening a transistor to a heat sink, the following cautions must be observed.

- (1) Too small a torque causes less heat removal; and too large a torque causes abnormal stress to be applied to the transistor, breaking down the transistor or shortening

its life considerably. Table 7.3 shows the optimum mounting torque for each type of case. Fig. 7.5 shows the relation between mounting torque and thermal resistance.

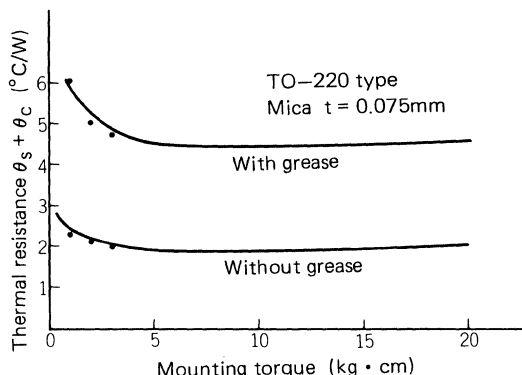


Fig. 7.5 Mounting Torque and Thermal Resistance

- (2) A flat head machine screw or tapping screw may be used to fasten the transistor to the heat sink. Care should be taken that if the time from start of fastening to completion is too short abnormal stress is applied to the transistor as impact and if an automation is used to fasten the transistor to the heat sink abnormal stress is applied to the transistor as vibration, impact. Do not use a flat head machine screw because its use causes abnormal stress to be applied to the transistor.
- (3) The use of an unsuitable heat sink provides less thermal effect or causes abnormal stress to be applied to the transistor, leading to deterioration in characteristics. The following are the requirements to be met by the heat sink.
 - (a) No warp of heat sink
 - (b) No press burr of aluminum plate, copper plate, iron plate
 - (c) Mounting hole chamfered
 - (d) Mounting surface being flat
 - (e) No foreign matter between heat sink and transistor
- (4) Recommended parts should be used for mounting.
- (5) Silicone grease is applied between the transistor and the heat sink to provide better thermal conduction. Care should be taken that oil in silicone grease of some kinds swells the coating material used in the

transistor, deteriorating the transistor considerably.

Standard Method of Fastening of Transistor to Heat Sink

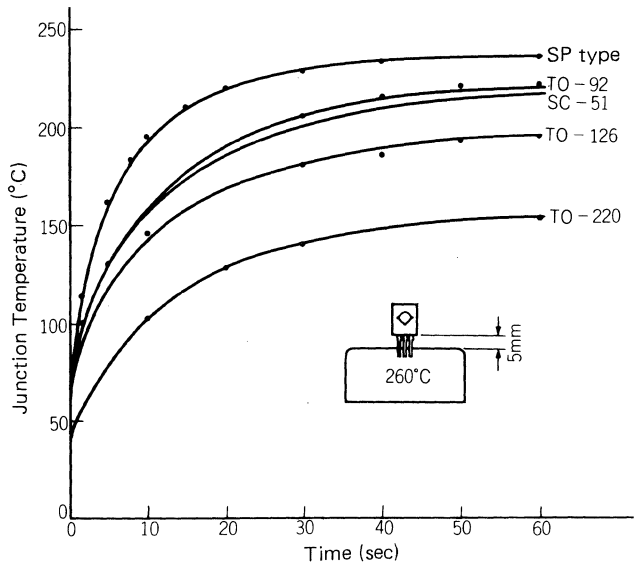
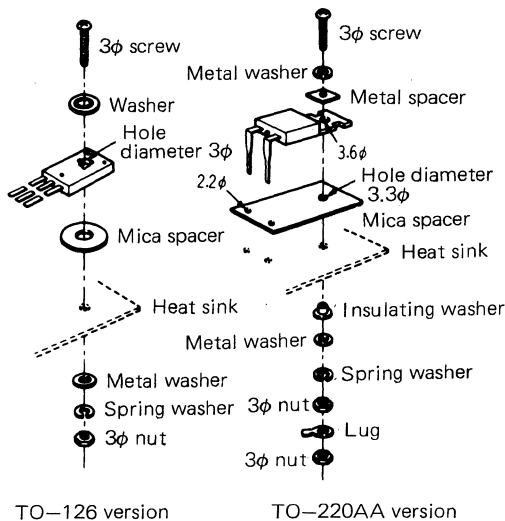


Fig. 7.6 Junction Temperature at Soldering

7.3 Others

7.3.1 Dielectric breakdown

Circuit design is performed under maximum ratings assigned to transistors to provide reliable circuit operation. However, transistors may break down before they are mounted on the circuit or during mounting. This breakdown is assumed to be caused by static electricity charged on the human body, packing material, or assembly equipment.

Static electricity exists everywhere in the process until transistors are mounted on the circuit. Above all, static electricity charged on the human body affects the most. There are cases where the human body is charged with electricity of several thousands of volts to several tens of thousands of volts depending on the humidity in a workshop, the material of the working clothes, underwear worn by a worker. It is assumed that when this voltage discharges through the electrodes of a transistor overvoltage causes breakdown to the transistor.

In actual cases, contact resistance between the human body and the transistor works to prevent breakdown from occurring and there arise no serious problems. However, transistors for high frequency use must be handled very carefully because their structure is so made as to be broken down easily by overvoltage.

7.2.4 Soldering

Transistors left to stand at a high temperature may deteriorate or break down. Soldering, whether it uses a soldering iron or flow solder, must be performed at the lowest possible temperature as quickly as possible. Fig. 7.6 shows junction temperature rise curves when soldering is performed. Flux with strong acidity or alkalinity for soldering may result in corrosion of the leads or deterioration in characteristics. It is important that the soldering area should be as apart from the transi-

When mounting transistors on the circuit, the following measures are taken against static electricity.

- (1) A conductive metal plate must be placed on the workbench to keep the chair, measuring instruments, jigs at the same potential. AC leakage of the measuring instruments must be as little as possible. The measuring instruments must be grounded completely.
- (2) The worker must wear a pair of cotton gloves or an electrostatic ring. The working clothes made of synthetic fiber must not be used. The working clothes must be anti-static.
- (3) For the soldering iron, leak current must be as low as possible or the tip of the soldering iron must be grounded. If a solder bath is used, it must be also grounded.
- (4) Equipment, such as belt conveyor, used during assembly must be grounded.
- (5) It is desirable that a high molecular substance, such as styrene foam, vinyl which are charged easily, should not be used as packing material for printed circuit boards or equipment.

Fig. 7.7 shows breakdown voltages for various types of transistor. The capacitor value is 100pF to 1000pF based on capacitance of the human body.

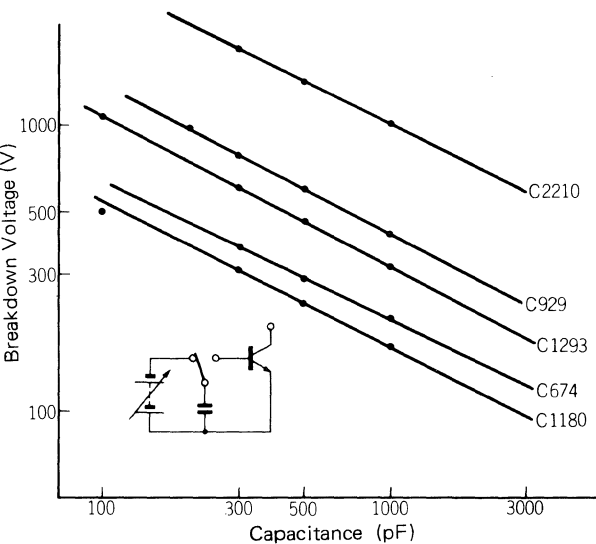


Fig. 7.7 Breakdown Voltage for Various Types of Transistors

7.3.2 Storage instructions

When storing transistors, the following must be observed; otherwise deterioration in characteristics, failure in soldering, or defect in appearance may occur.

- (1) Transistors shall not be exposed to direct sunlight and shall be stored in an indoor place where there is not very much change in temperature, humidity. (Storage conditions: 5 to 30°C, 40 to 60%RH)
- (2) The storage place shall be free from poisonous gas and dust.
- (3) If it is necessary for transistors to be stored for a long time, they shall remain unprocessed.
- (4) Storage containers shall be hard to be static-electrified.
- (5) No excessive load shall be applied to transistors during storage.

2SA-TYPE (HF PNP)

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All specifications and characteristics shown on the following pages are for standard products. Data shown on individual figures, except P_C derating curve and ASO, are represented by typical values. Ambient temperature T_a is 25°C unless otherwise specified.

2SA608, 608K



2000B



2003A

PNP Epitaxial Planar
Silicon Transistors

General-Purpose Amp, Switching Applications

©334G

Features

- The 2SA608 is classified into 2 types of SP, NP according to the case outline.
- The NP type is subclassified into 2 subtypes according to the breakdown voltage.
- The 2SC536 is available as an NPN type version of the 2SA608.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

		2SA608SP	2SA608NP	2SA608KNP	unit
Collector to Base Voltage	V_{CBO}	-40	-40	-55	V
Collector to Emitter Voltage	V_{CEO}	-30	-30	-50	V
Emitter to Base Voltage	V_{EBO}	-5	-5	-5	V
Collector Current	I_C	-100	-100	-100	mA
Peak Collector Current	i_{cp}	300	300	300	mA
Collector Dissipation	P_C	200	400	400	mW
Junction Temperature	T_j	125	125	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +125	-55 to +125	-55 to +125	$^\circ\text{C}$

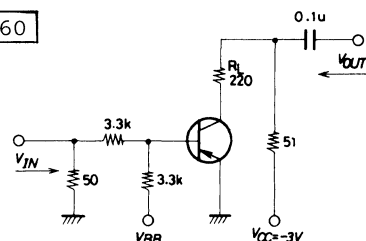
Electrical Characteristics at $T_a=25^\circ\text{C}$

		min	typ	max	unit
Collector Cutoff Current	I_{CBO}			-1	μA
Emitter Cutoff Current	I_{EBO}			-1	μA
DC current Gain	h_{FE}^*	60*	150	560*	
Gain Bandwidth Product	f_T		180		MHz
Output Capacitance	c_{ob}		7		pF
C-E Saturation Voltage	$V_{CE(sat)}$			-0.5	V
Turn On Time	t_{on}		50		ns
Turn Off Time	t_{off}		210		ns

$V_{CB}=-25\text{V}, I_E=0$
 $V_{EB}=-4\text{V}, I_C=0$
 $V_{CE}=-6\text{V}, I_C=-1\text{mA}$
 $V_{CE}=-6\text{V}, I_C=-10\text{mA}$
 $V_{CB}=-6\text{V}, f=1\text{MHz}$
 $I_C=-50\text{mA}, I_B=-5\text{mA}$
 $V_{IN}=-12\text{V}, V_{BB}=+3\text{V}, \text{at}$
 appointed circuit.
 $V_{IN}=+12\text{V}, V_{BB}=-4\text{V}, \text{at}$
 appointed circuit.

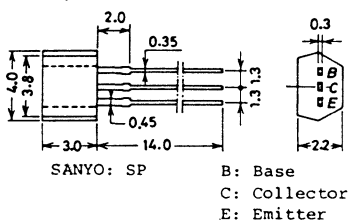
*2SA608 is graded as follows by h_{FE} at 1A :

60	D	120	100	E	200	160	F	320	280	G	560
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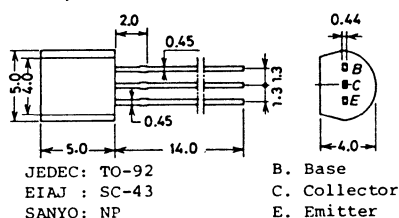


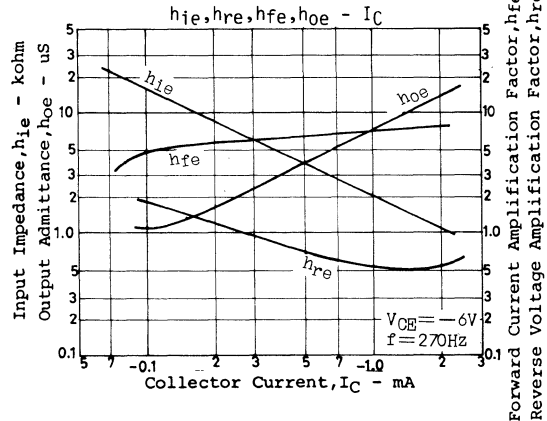
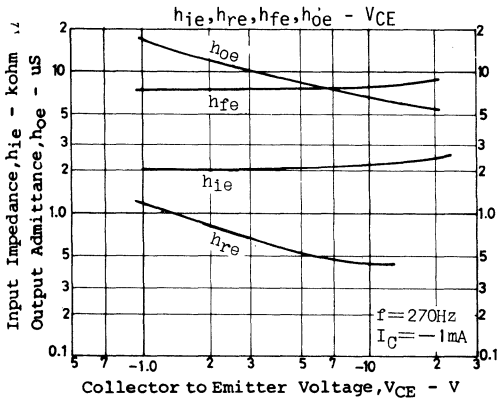
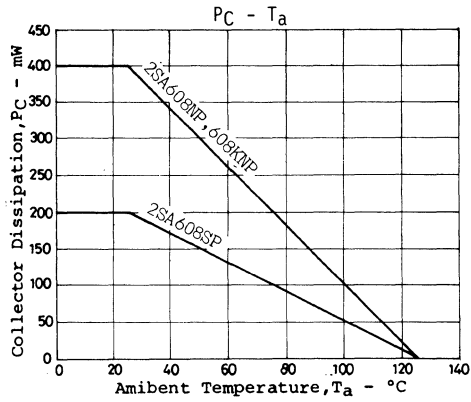
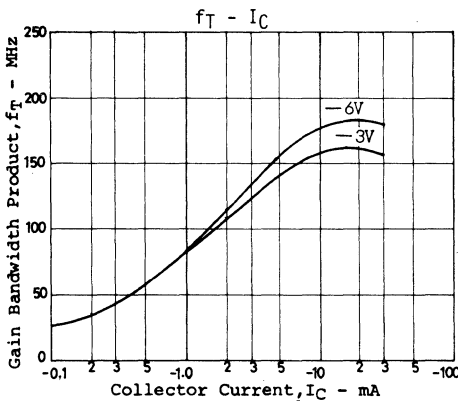
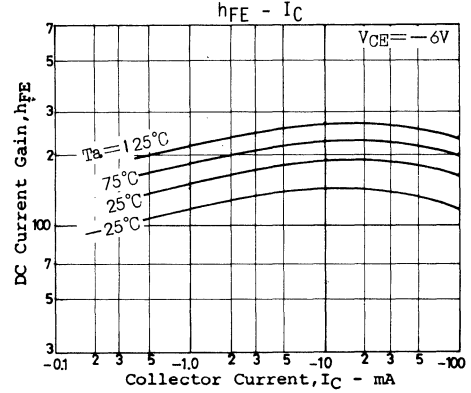
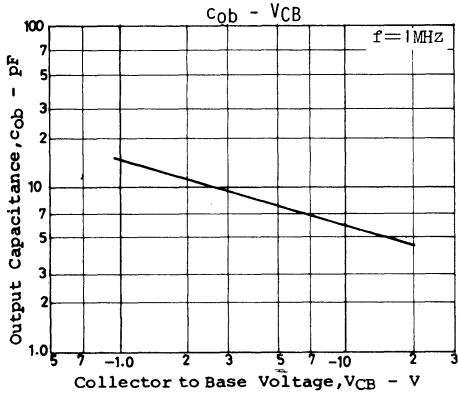
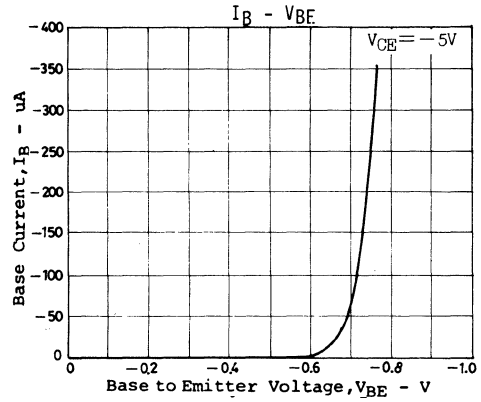
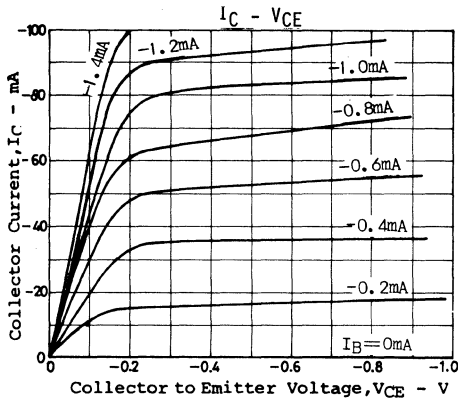
Switching time measurement circuit

Case Outline 2000B (unit:mm)



Case Outline 2003A (unit:mm)





2SA929, 930



2003A

PNP Epitaxial Planar
Silicon Transistors

Very Low Noise Amp Applications

©371C

The 2SA929, 930 are transistors for very low noise AF amp. They are especially suited for use in the first stage of equalizer amp. in high-grade stereo sets. It is possible to form a complementary pair with NPN type 2SC1570,1571.

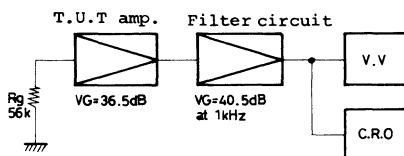
Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$		2SA929	2SA930	unit
Collector to Base Voltage	V_{CB0}	-55	-40	V
Collector to Emitter Voltage	V_{CE0}	-50	-35	V
Emitter to Base Voltage	V_{EB0}		-5	V
Collector Current	I_C		-50	mA
Allowable Power Dissipation	P_C		200	mW
Junction Temperature	T_j		125	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +125		$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=-30\text{V}, I_E=0$			-0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=-4\text{V}, I_C=0$			-0.1	μA
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=-10\mu\text{A}, I_E=0$	2SA929	-55		V
			2SA930	-40		V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=-1\text{mA}, R_{BE}=\infty$	2SA929	-50		V
			2SA930	-35		V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=-10\mu\text{A}, I_C=0$		-5		V
DC Current Gain	h_{FE}^*	$V_{CE}=-6\text{V}, I_C=-1\text{mA}$		160*	960*	
Gain Bandwidth Product	f_T	$V_{CE}=-6\text{V}, I_C=-1\text{mA}$		80		MHz
Output Capacitance	c_{ob}	$V_{CB}=-6\text{V}, f=1\text{MHz}$		5		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=-50\text{mA}, I_E=-5\text{mA}$			-0.5	V
Output Noise Voltage	V_{NO}	$V_{CC}=-30\text{V}, I_C=-1\text{mA}, R_g=56\text{kohm}, V_G=77\text{dB}(1\text{kHz})$			35	mV
	$V_{NO(peak)}$	Same as above			200	mV

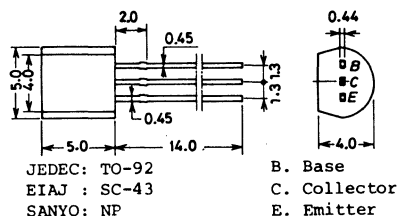
* The 2SA929/930 are classified as follows according to h_{FE} at 1mA.

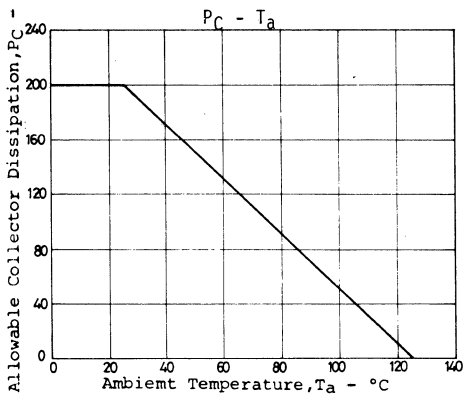
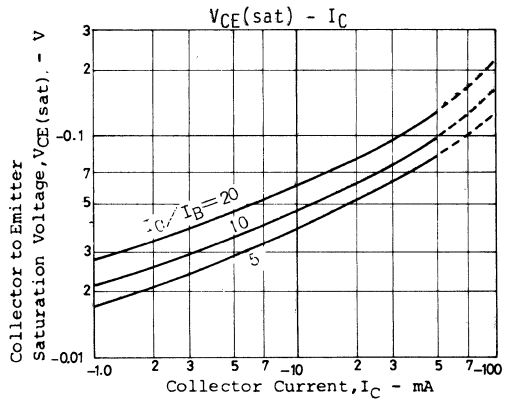
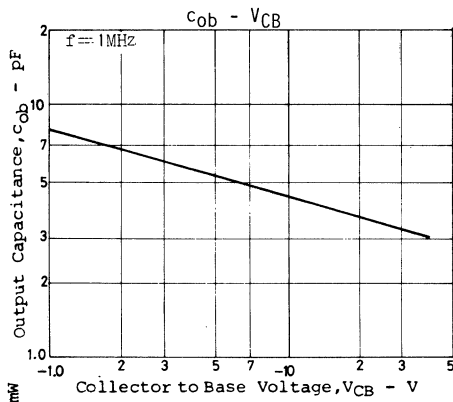
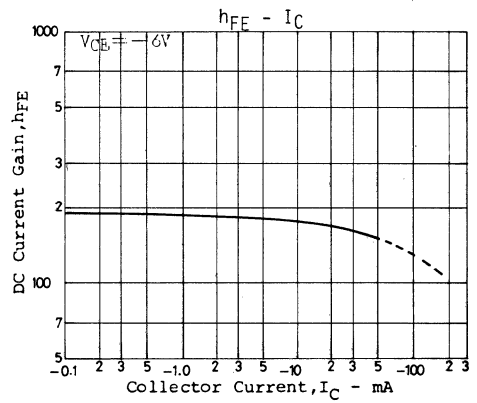
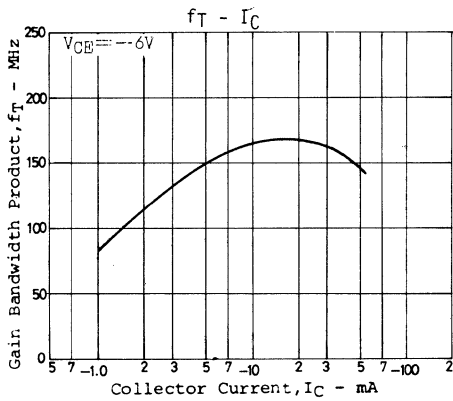
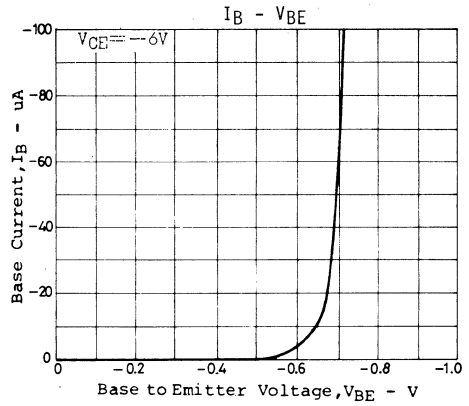
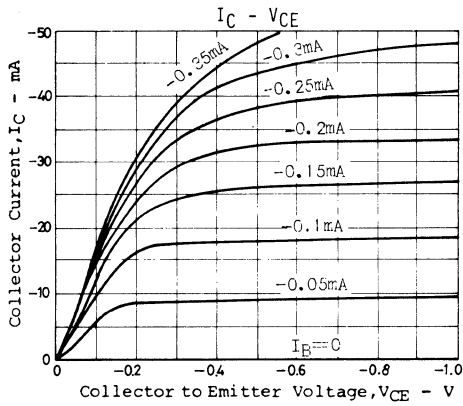
160	F	320	280	G	560	480	H	960
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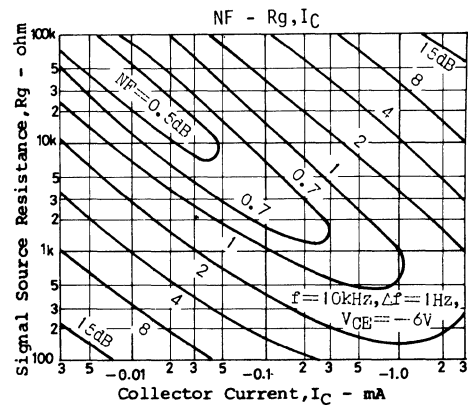
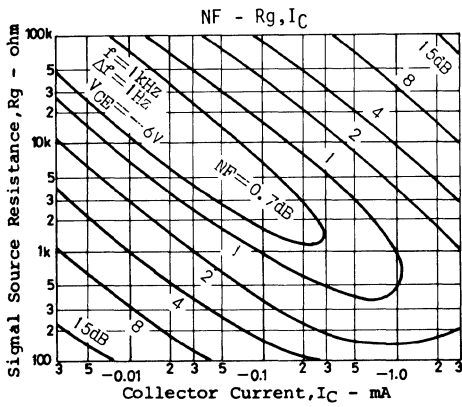
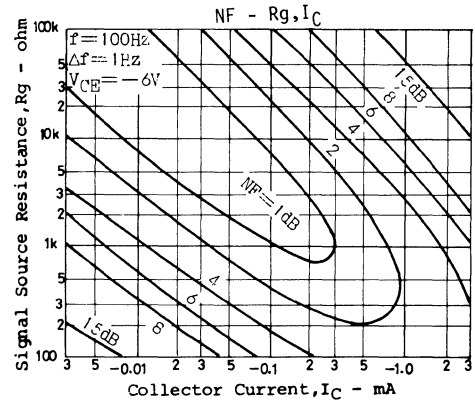
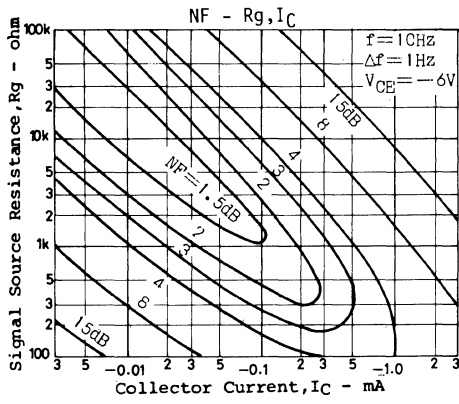
Noise Test Circuit



Case Outline 2003A (unit:mm)







2SA984, 984K



2003A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC2274, 2274K

Low Frequency Power Amp Applications

©465E

Features

- High breakdown voltage ($V_{CE0} \geq 50/80V$).
- High current ($I_C = 500mA$).
- Low saturation voltage.

(): 2SA984, 984K

Absolute Maximum Ratings at $T_a = 25^\circ C$

		A984, C2274	A984K, C2274K	unit
Collector to Base Voltage	V_{CBO}	(-) 60	(-) 100	V
Collector to Emitter Voltage	V_{CEO}	(-) 50	(-) 80	V
Emitter to Base Voltage	V_{EBO}		(-) 5	V
Collector Current	I_C	(-) 500		mA
	i_{cp}	(-) 800		mA
Collector Dissipation	P_C	600		mW
Junction Temperature	T_j	150		$^\circ C$
Storage Temperature	T_{stg}	-55 to +150		$^\circ C$

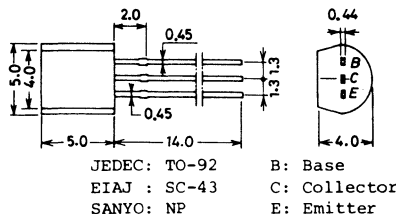
Electrical characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-) 40V, I_E = 0$			(-) 1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-) 4V, I_C = 0$			(-) 1.0	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = (-) 5V, I_C = (-) 50mA$	60*		320*	
	$h_{FE}(2)$	$V_{CE} = (-) 5V, I_C = (-) 400mA, \text{pulse}$	35			
G-B Product	f_T	$V_{CE} = (-) 10V, I_C = (-) 10mA$		120		MHz
Output Capacitance	C_{ob}	$V_{CB} = (-) 10V, f = 1MHz$		(9)		pF
				5		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-) 400mA, I_E = (-) 40mA$		(-0.25)	(-0.6)	V
B-E Saturation Voltage	$V_{BE(sat)}$	" "		0.2	0.6	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-) 10\mu A, I_E = 0$			(-) 0.9	V
		A984, C2274 (-) 60				V
		A984K, C2274K (-) 100				V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-) 1mA, R_{BE} = \text{open}$			(-) 50	V
		A984, C2274 (-) 50				V
		A984K, C2274K (-) 80				V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-) 10\mu A, I_C = 0$			(-) 5	V

* The 2SA984, K, 2SC2274, K are classified by 50mA h_{FE} as follows.

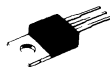
60	D	120	100	E	200	160	F	320
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Case Outline 2003A
(unit:mm)



For details, refer to the description of the 2SC2274, 2274K.

2SA1011



2010A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC2344

High Voltage Switching, AF 100W Driver Applications

©544D

(): 2SA1011

Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CBO}	(-)180	V
Collector to Emitter Voltage	V_{CEO}	(-)160	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)1.5	A
Peak Collector Current	i_{cp}	(-)3	A
Collector Dissipation	P_C	25	W
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

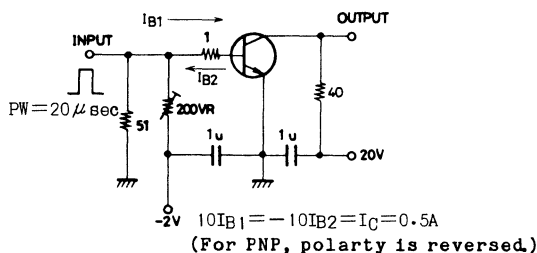
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)120V, I_E=0$			(-)10	uA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$			(-)10	uA
DC Current Gain	h_{FE}^*	$V_{CE}=(-)5V, I_C=(-)300mA$	60*		200*	
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		100		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10V, f=1MHz$		(30)		pF
				23		pF
Base to Emitter Voltage	V_{BE}	$V_{CE}=(-)5V, I_C=(-)10mA$			(-)1.5	V
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500mA, I_B=(-)50mA$		(-0.5)		V
				0.3		V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)1mA, I_E=0$			(-)180	V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, I_{BE}=\infty$			(-)160	V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)1mA, I_C=0$			(-)6	V
Turn-ON Time	t_{on}	at specified Test Circuit		(0.29)0.15		usec
Fall Time	t_f	"		(0.19)0.48		usec
Storage Time	t_{stg}	"		(0.48)0.81		usec

* The 2SA1011/2SC2344 are classified by 300mA h_{FE} as follows:

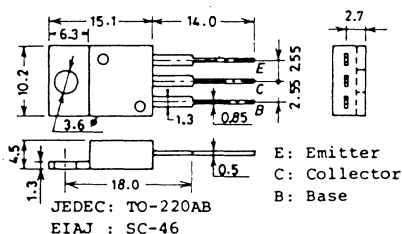
60	D	120	100	E	200
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Switching Time Test Circuit



Case Outline 2010A

(unit:mm)



For details, refer to the description of the 2SC2344.

2SA1016, 1016K



2003A

PNP/NPN Epitaxial Planar
Silicon Transistors

**2SC2362,
2362K**

**High Voltage,
Low Noise Amp Applications**

©572C

(): 2SA1016, 1016K

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

	2SA1016, 2SC2362	2SA1016K, 2SC2362K	unit
Collector to Base Voltage	V_{CBO}	(-) 120	V
Collector to Emitter Voltage	V_{CEO}	(-) 100	V
Emitter to Base Voltage	V_{EBO}	(-) 5	V
Collector Current	I_C	(-) 50	mA
Peak Collector Current	i_{cp}	(-) 100	mA
Collector Dissipation	P_C	400	mW
Junction Temperature	T_j	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +125	$^\circ\text{C}$

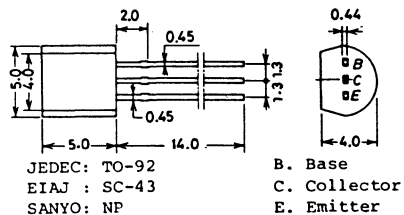
Electrical Characteristics at $T_a=25^\circ\text{C}$

		min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-) 80\text{V}, I_E=0$	(-) 1.0		μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-) 4\text{V}, I_C=0$	(-) 1.0		μA
DC Current Gain	h_{FE}^*	$V_{CE}=(-) 6\text{V}, I_C=(-) 1\text{mA}$	160*	960*	
Gain Band-width Product	f_T	$V_{CE}=(-) 6\text{V}, I_C=(-) 1\text{mA}$	(110) (130)		MHz
Output Capacitance	C_{ob}	$V_{CB}=(-) 10\text{V}, f=1\text{MHz}$	(2.2) 1.8		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-) 10\text{mA}, I_B=(-) 1\text{mA}$	(-) 0.5		V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-) 10\mu\text{A}, I_E=0$	(-) 120		V
		$[A1016, C2362]$			
		$I_C=(-) 10\mu\text{A}, I_E=0$	(-) 150		V
		$[A1016K, C2362K]$			
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-) 1\text{mA}, R_{BE}=\infty$	(-) 100		V
		$[A1016, C2362]$			
		$I_C=(-) 1\text{mA}, R_{BE}=\infty$	(-) 120		V
		$[A1016K, C2362K]$			
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-) 10\mu\text{A}, I_C=0$	(-) 5		V
Noise Level	$V_{NO(ave)}$	$V_{CC}=30\text{V}, I_C=1\text{mA}, R_g=56\text{kohm}$ $V_G=77\text{dB/1kHz}$		35	mV
Noise Peak Level	$V_{NO(peak)}$	" " "		200	mV

* The 2SA1016, K, 2SC2362, K are classified by $1\text{mA } h_{FE}$ as follows :

160	F	320	280	G	560	480	H	960
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Case Outline 2003A
(unit:mm)



For details, refer to the description of the 2SC2362, 2362K.

2000B

PNP Epitaxial Planar Silicon Transistor

High Frequency, General-Purpose Amp Applications

Ⓔ851E

Use

- . Ideally suited for use in FM RF amplifiers, mixers, oscillators, converters, IF amplifiers.

Features

- . High f_T (230MHz typ.) and small c_{re} (1.1pF typ.).
- . Small NF (2.5dB typ.).

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

Solute Maximum Ratings at T _a =25°C			unit
Collector to Base Voltage	V _{CB0}	-30	V
Collector to Emitter Voltage	V _{CEO}	-20	V
Emitter to Base Voltage	V _{EB0}	-5	V
Collector Current	I _C	-30	mA
Collector Dissipation	P _C	150	mW
Junction Temperature	T _j	125	°C
Storage Temperature	T _{stg}	-55 to +125	°C

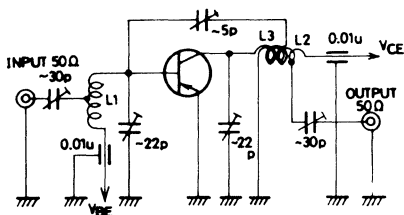
Electrical Characteristics at $T_a=25^\circ\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{\text{CB}}=-10\text{V}, I_{\text{E}}=0$			-0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{\text{EB}}=-4\text{V}, I_{\text{C}}=0$			-0.1	μA
DC Current Gain	h_{FE}	$V_{\text{CE}}=-6\text{V}, I_{\text{C}}=-1\text{mA}$	60*		320*	
Gain Bandwidth Product	f_{T}	$V_{\text{CE}}=-6\text{V}, I_{\text{C}}=-1\text{mA}$	150	230		MHz
Feedback Capacitance	c_{re}	$V_{\text{CB}}=-6\text{V}, f=1\text{MHz}$		1.1	1.7	pF
B to C Time Constant	$\tau_{\text{bb}}, c_{\text{c}}$	$V_{\text{CB}}=-6\text{V}, I_{\text{C}}=-1\text{mA}, f=31.9\text{MHz}$		11	20	ps
Noise Figure	NF	$V_{\text{CE}}=-6\text{V}, I_{\text{C}}=-1\text{mA}, f=100\text{MHz}$		2.5		dB
Power Gain	PG	$V_{\text{CE}}=-6\text{V}, I_{\text{C}}=-1\text{mA}, f=100\text{MHz}$		22		dB

* 2SA1177 is classified as follows according to h_{FE} at 1mA.

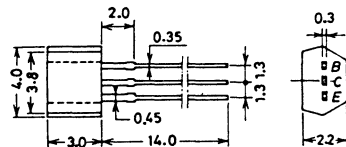
60	D	120	100	E	200	160	F	320
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NF, PG Test Circuit



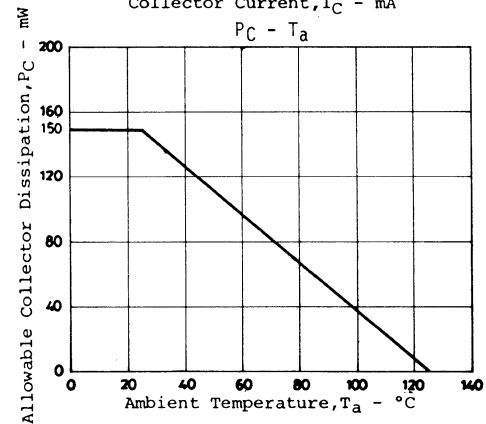
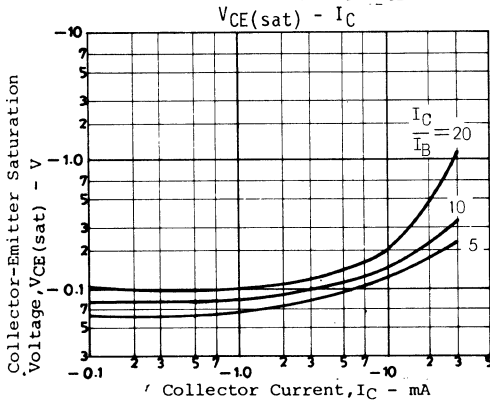
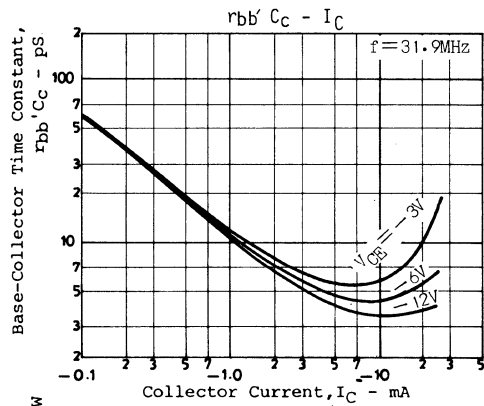
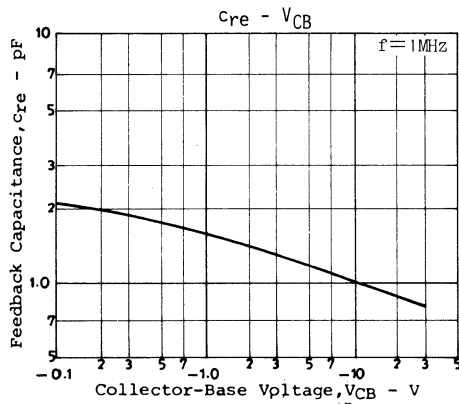
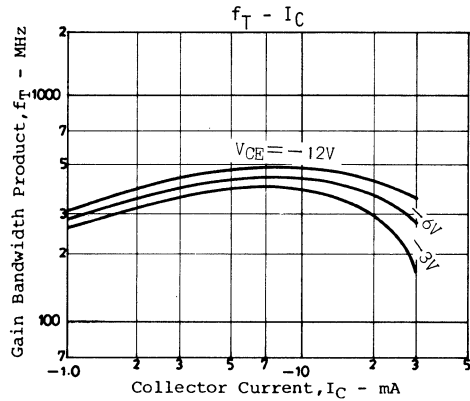
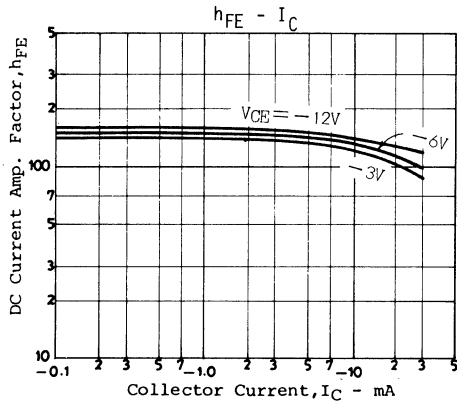
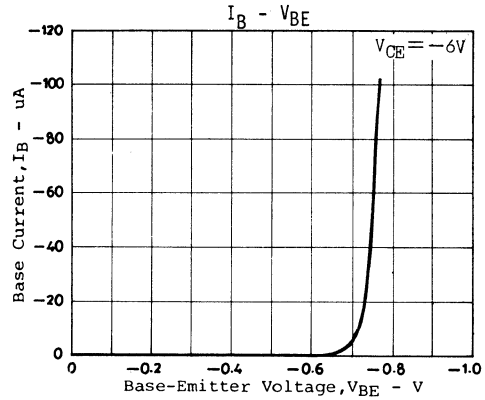
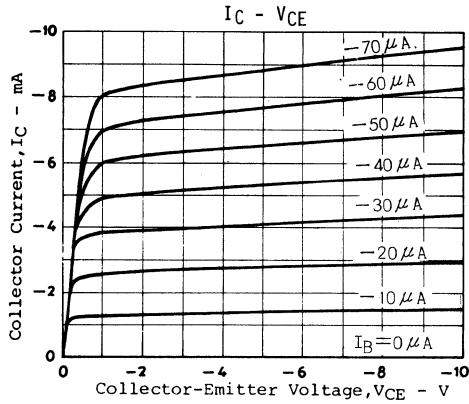
- L₁: 1mm $\varnothing$ plated wire 10mm $\varnothing$ 5T, tapped at 2T from V_{BE} side.
L₂: 1mm $\varnothing$ plated wire 10mm $\varnothing$ 7T, tapped at 1T from V_{CE} side.
L₃: 1mm $\varnothing$ enameled wire 10mm $\varnothing$ 3T.

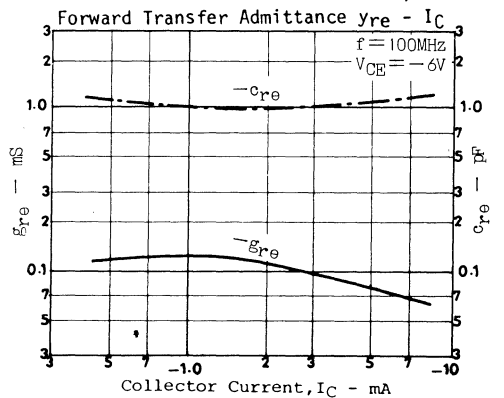
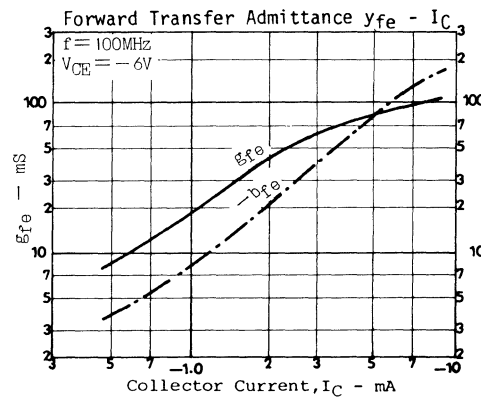
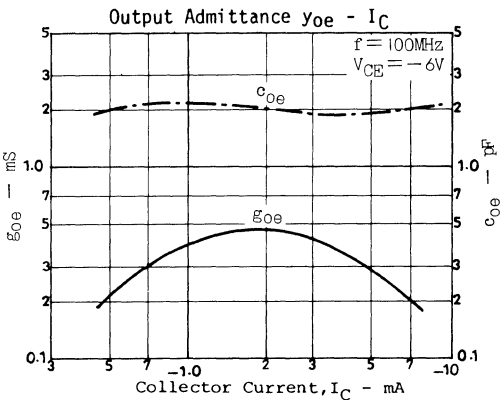
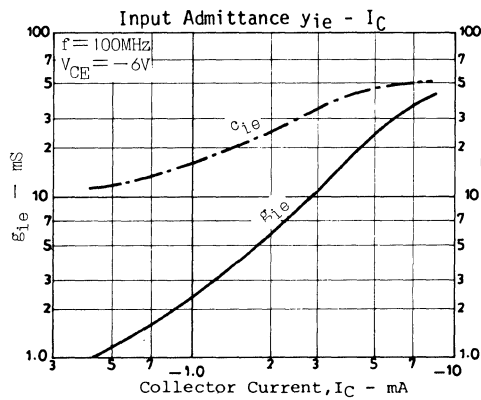
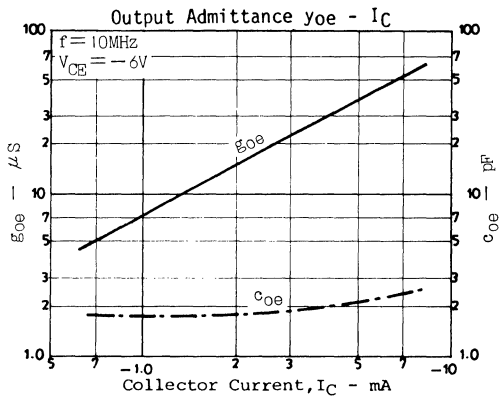
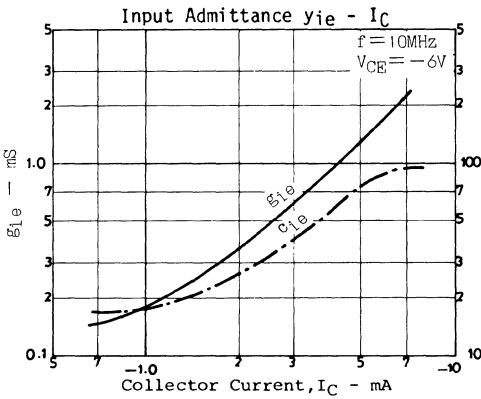
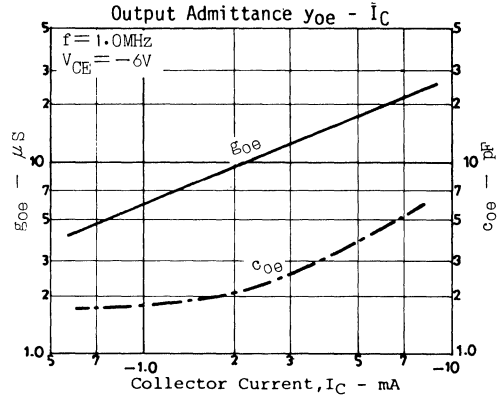
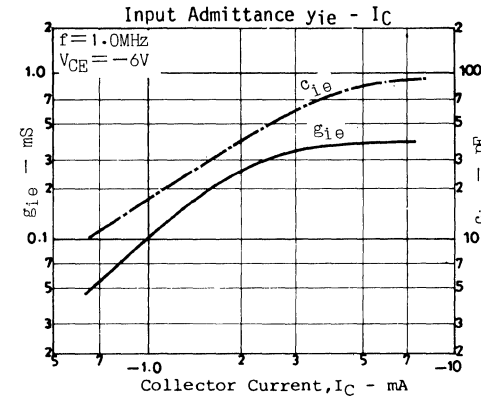
Case Outline . 2000B
(unit:mm)

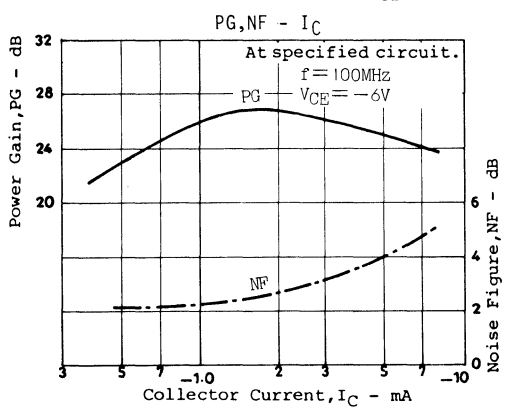
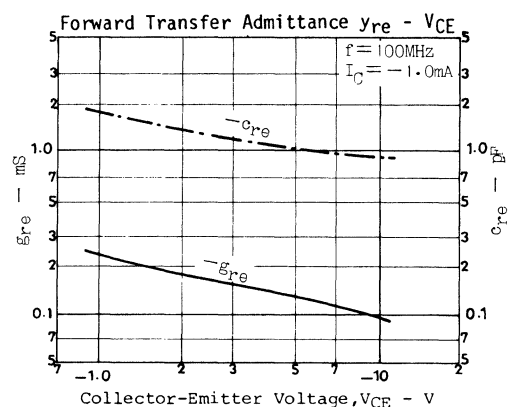
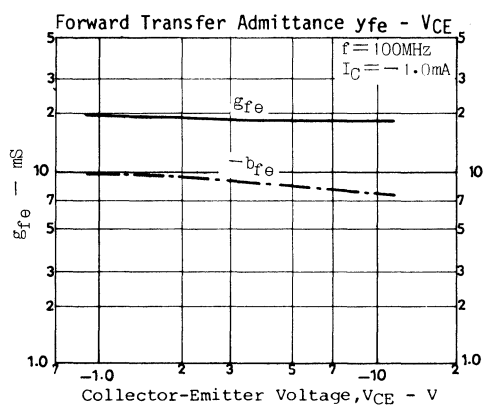
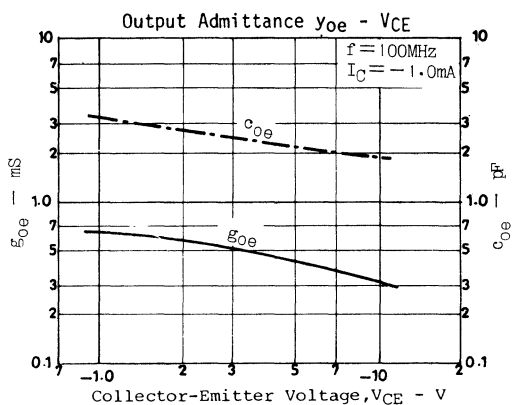
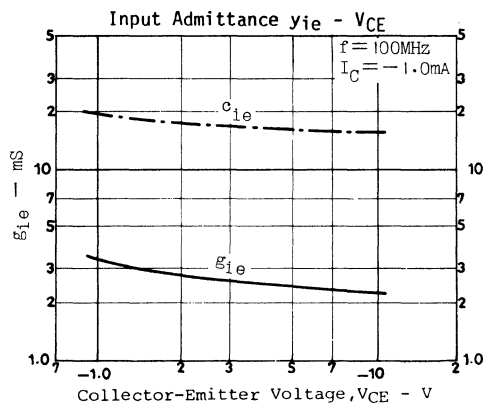


SANYO: SP

B: Base
C: Collector
E: Emitter







2SA1179



2018

PNP Epitaxial Planar
Silicon Transistor

Low Frequency, General-Purpose Amp Applications

©690C

Features

- Very small package enabling compactness and slimness of sets
- High breakdown voltage ($V_{CEO} = -50$ V)

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

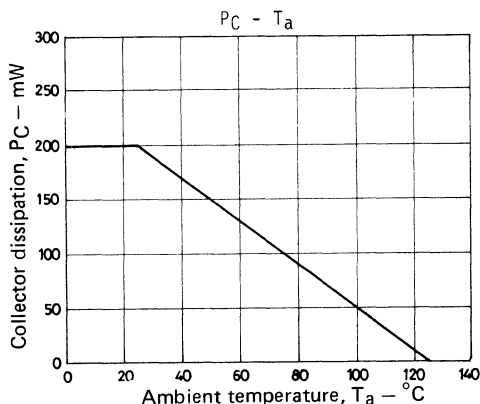
			unit
Collector to base voltage	V_{CBO}	-55	V
Collector to emitter voltage	V_{CEO}	-50	V
Emitter to base voltage	V_{EBO}	-5	V
Collector current	I_C	-150	mA
Peak collector current	I_{cp}	-300	mA
Collector dissipation	P_C	200	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ~ +125	$^\circ\text{C}$

Electrical Characteristics/ $T_a = 25^\circ\text{C}$

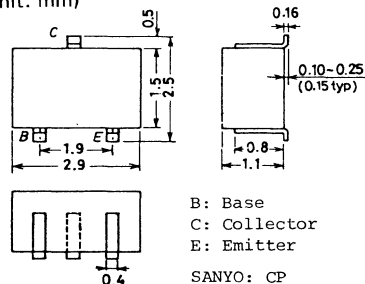
			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = -35\text{V}, I_E = 0$			-0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = -4\text{V}, I_C = 0$			-0.1	μA
DC current gain	h_{FE}	$V_{CE} = -6\text{V}, I_C = -1\text{mA}$	90*		600*	
Gain band width product	f_T	$V_{CE} = -6\text{V}, I_C = -10\text{mA}$		180		MHz
Output capacitance	C_{ob}	$V_{CB} = -6\text{V}, f = 1\text{MHz}$		7		pF
Collector to emitter saturation voltage	$V_{CE(sat)}$	$I_C = -50\text{mA}, I_B = -5\text{mA}$	-0.15	-0.5		V

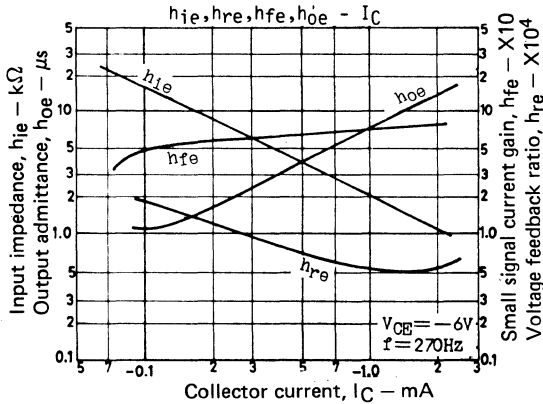
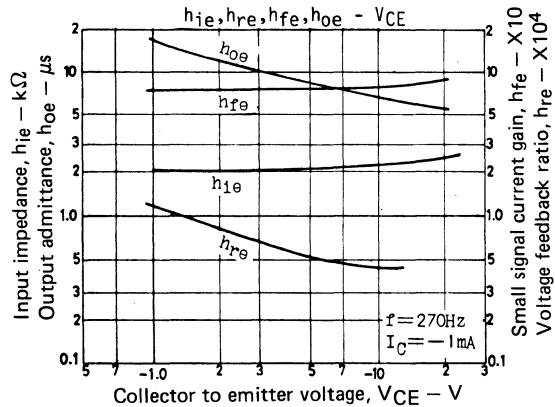
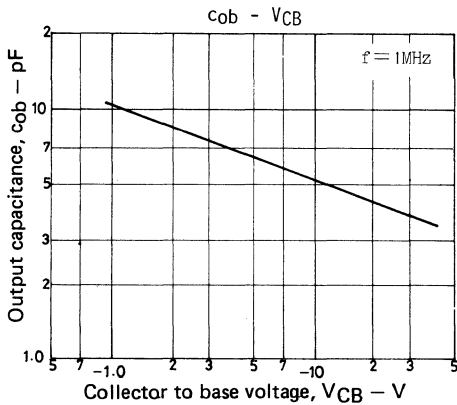
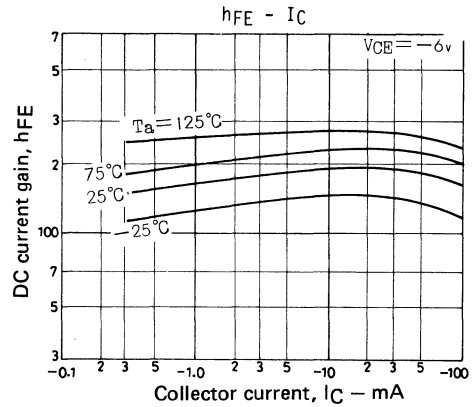
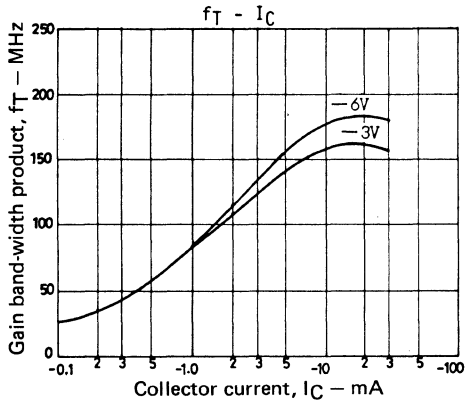
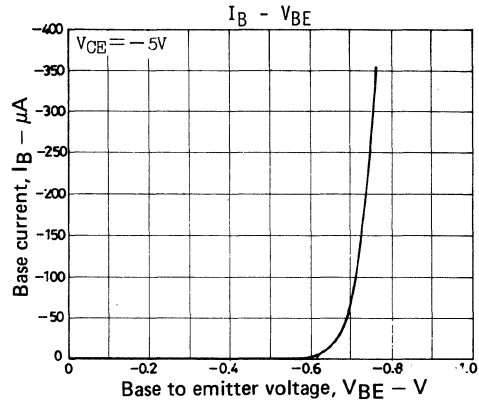
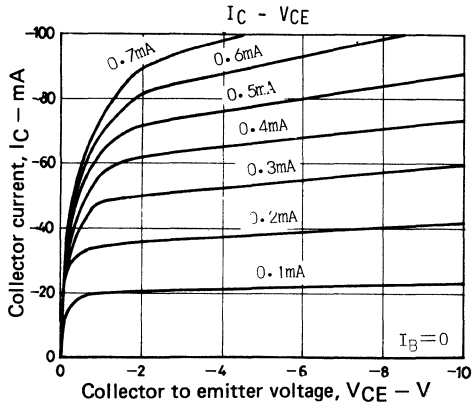
*: The 2SA1179 is classified by -1 mA h_{FE} as follows:

90	M4	180	135	M5	270	200	M6	400	300	M7	600
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Case Outline 2018
(unit: mm)





2SA1207



2003A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC2909

High Voltage Switching, AF 60W Predriver Applications

©778C

Features

- . Adoption of FBET process.
- . High breakdown voltage.
- . Excellent linearity of h_{FE} and small c_{ob} .
- . Fast switching speed.

(): 2SA1207

Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)180	V
Collector to Emitter Voltage	V_{CEO}	(-)160	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)70	mA
Peak Collector Current	i_{cp}	(-)140	mA
Collector Dissipation	P_C	600	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

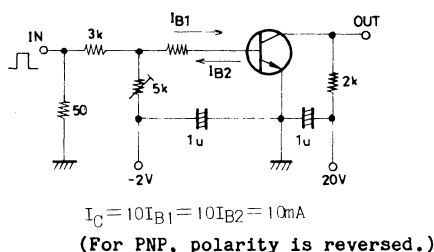
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80\text{V}, I_E=0$		(-)0.1		μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$		(-)0.1		μA
DC Current Gain	h_{FE}^*	$V_{CE}=(-)5\text{V}, I_C=(-)10\text{mA}$	100*		400*	
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)10\text{mA}$		150		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(2.5)		pF
				2.0		
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)30\text{mA}, I_B=(-)3\text{mA}$		(0.14)(0.4)		V
				0.08	0.3	
Turn-ON Time	t_{on}	at specified test circuit		0.1		μsec
Storage Time	t_{stg}	"		0.2		μsec
Fall Time	t_f	"		1.0		μsec

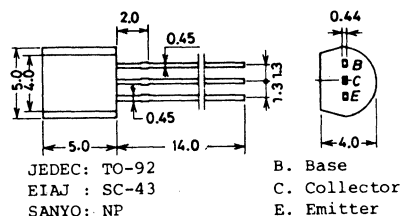
* The 2SA1207/2SC2909 are classified by 10mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400
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Switching Time Test Circuit



Case Outline 2003A (unit:mm)



For details, refer to the description of the 2SC2909.

2SA1208



2006A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC2910

High Voltage Switching, AF 80W Predriver Applications

©781C

Features

- FBET series
- High breakdown voltage
- Good linearity of h_{FE} and small c_{ob}
- Fast switching speed

(): 2SA1208

Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Collector to base voltage	V_{CBO}	(-) 180	V
Collector to emitter voltage	V_{CEO}	(-) 160	V
Emitter to base voltage	V_{EBO}	(-) 5	V
Collector current	I_C	(-) 70	mA
Peak collector current	i_{cp}	(-) 140	mA
Collector dissipation	P_C	900	mW
Junction temperature	T_j	150	$^\circ\text{C}$
Storage temperature	T_{stg}	$-55 \sim 150$	$^\circ\text{C}$

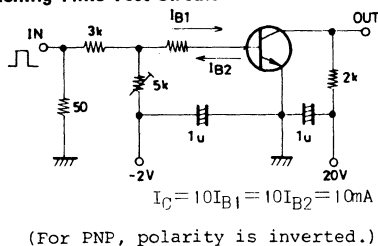
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = (-)80\text{ V}, I_E = 0$			(-) 0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = (-)4\text{ V}, I_C = 0$			(-) 0.1	μA
Common emitter DC current gain	h_{FE}^*	$V_{CE} = (-)5\text{ V}, I_C = (-)10\text{ mA}$	100^*		400^*	
Gain band-width product	f_T	$V_{CE} = (-)10\text{ V}, I_C = (-)10\text{ mA}$		150		MHz
Common base output capacitance	c_{ob}	$V_{CB} = (-)10\text{ V}, f = 1\text{ MHz}$		(2.5)		pF
Collector to emitter saturation voltage $V_{CE(sat)}$		$I_C = (-)30\text{ mA}, I_B = (-)3\text{ mA}$		(-0.14)	(-0.4)	V
Turn-on time	t_{on}	At specified test circuit		0.1		μsec
Fall time	t_f	At specified test circuit		0.2		μsec
Storage time	t_{stg}	At specified test circuit		1.0		μsec

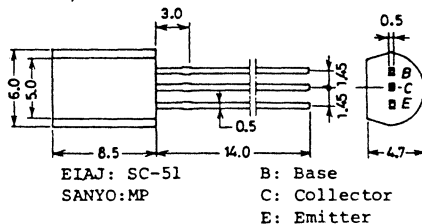
*: The 2SA1208/2SC2910 are classified by 10 mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400
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Switching Time Test Circuit

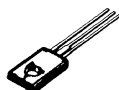


Case Outline 2006A (unit: mm)



For details, refer to the description of the 2SC2910.

2SA1209



2009

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC2911

High Voltage Switching, AF 100W Predriver Applications

©779B

Features

- Adoption of FBET process
- High breakdown voltage
- Good linearity of h_{FE} and small c_{ob}
- Fast switching speed

(): 2SA1209

Maximum Ratings/ $T_a = 25^\circ\text{C}$

Maximum Ratings/T _a = 25°C			unit	
Collector to base voltage	V _{CBO}	(-)180	V	
Collector to emitter voltage	V _{CEO}	(-)160	V	
Emitter to base voltage	V _{EBO}	(-)5	V	
Collector current	I _C	(-)140	mA	
Peak collector current	i _{cp}	(-)200	mA	
Collector dissipation	P _C	1	W	
		T _C = 25°C	10	W
Junction temperature	T _j	150	°C	
Storage temperature	T _{sta}	-55 ~ +150	°C	

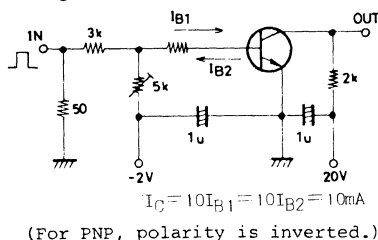
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = (-)80, I_E = 0$			(-)0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = (-)4 \text{ V}, I_C = 0$			(-)0.1	μA
Common emitter DC current gain	h_{FE}^*	$V_{CE} = (-)5 \text{ V}, I_C = (-) 10 \text{ mA}$	100*		400*	
Gain band-width product	f_T	$V_{CE} = (-)10 \text{ V}, I_C = (-) 10 \text{ mA}$		150		MHz
Common base output capacitance	c_{ob}	$V_{CB} = (-)10 \text{ V}, f = 1 \text{ MHz}$		(4.0)		pF
				3.0		
Collector to emitter saturation voltage $V_{CE(sat)}$		$I_C = (-)50 \text{ mA}, I_B = (-)5 \text{ mA}$	(-0.14)	(-0.4)		V
			0.07	0.3		
Turn-on time	T_{on}	At specified test circuit		0.1		μs
Storage time	t_{stg}	At specified test circuit		1.5		μs
Fall time	t_f	At specified test circuit		0.1		μs

*: The 2SA1209/2SC2911 are classified by 10 mA h_{FE} as follows:

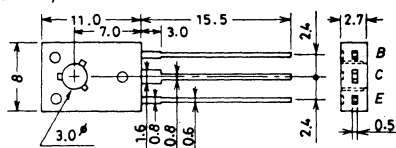
100	R	200	140	S	280	200	T	400
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Switching Time Test Circuit



Case Outline 2009

(unit: mm)



JEDEC: TO-126

B: Base
C: Collector
E: Emitter

For details, refer to the description of the 2SC2911.

2SA1210



PNP/NPN Epitaxial Planar
Silicon Transistors

2009

2SC2912

High Voltage Switching, AF 150W Predriver Applications

©/780B

Features

- Adoption of FBET process
- High breakdown voltage
- Good linearity of h_{FE} and small c_{ob}
- Fast switching speed

(): 2SA1210

Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Collector to base voltage	V_{CBO}	(-)-200	V
Collector to emitter voltage	V_{CEO}	(-)-200	V
Emitter to base voltage	V_{EBO}	(-)-5	V
Collector current	I_C	(-)-140	mA
Peak collector current	i_{cp}	(-)-200	mA
Collector dissipation	P_C	1	W
		10	W
Junction temperature	T_j	150	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ~ +150	$^\circ\text{C}$

$T_c = 25^\circ\text{C}$

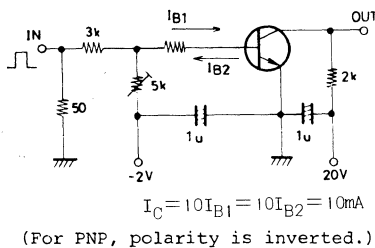
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = (-)160, I_E = 0$			(-)-0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = (-)4 \text{ V}, I_C = 0$			(-)-0.1	μA
Common emitter DC current gain	h_{FE}^*	$V_{CE} = (-)5 \text{ V}, I_C = (-) 10 \text{ mA}$	100*		400*	
Gain band-width product	f_T	$V_{CE} = (-)10 \text{ V}, I_C = (-) 10 \text{ mA}$		150		MHz
Common base output capacitance	c_{ob}	$V_{CB} = (-)10 \text{ V}, f = 1 \text{ MHz}$		(4.0)		pF
				3.0		
Collector to emitter saturation voltage $V_{CE(sat)}$		$I_C = (-)50 \text{ mA}, I_B = (-)5 \text{ mA}$		(-0.14)	(-0.4)	V
				0.07	0.3	
Turn-on time	T_{on}	At specified test circuit		0.1		μs
Storage time	t_{stg}	At specified test circuit		1.5		μs
Fall time	t_f	At specified test circuit		0.1		μs

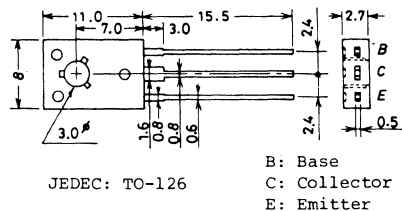
*: The 2SA1210/2SC2912 are classified by 10 mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400
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Switching Time Test Circuit



Case Outline 2009 (unit: mm)



For details, refer to the description of the 2SC2912.

2SA1237



2029A



2030A

PNP Epitaxial Planar
Silicon Composite Transistor

Differential Amp Applications

©957B

Applications

- . Differential amp, current mirror, temperature compensator.

Features

- . Excellent in thermal equilibrium and suited for use in differential amp applications.
- . Matched pair capability.

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	-55	V
Collector to Emitter Voltage	V_{CE0}	-50	V
Emitter to Base Voltage	V_{EB0}	-5	V
Collector Current	I_C	-150	mA
Peak Collector Current	i_{cp}	-300	mA
Collector Dissipation	P_C	200	mW
Total Dissipation	P_T	400	mW
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

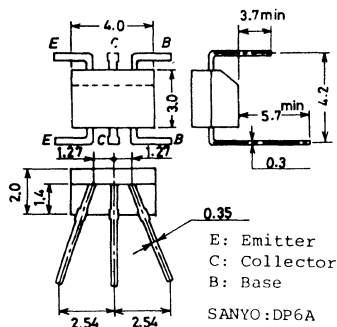
			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=-35\text{V}, I_E=0$			-0.1	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=-4\text{V}, I_C=0$			-0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=-6\text{V}, I_C=-1\text{mA}$	100		560	
DC Current Gain Ratio	$h_{FE(\text{small}/\text{large})}$	$V_{CE}=-6\text{V}, I_C=-1\text{mA}$	0.85	0.98		

* The 2SA1237 is classified by h_{FE} (small) as follows:

100	E	200	160	F	320	280	G	560
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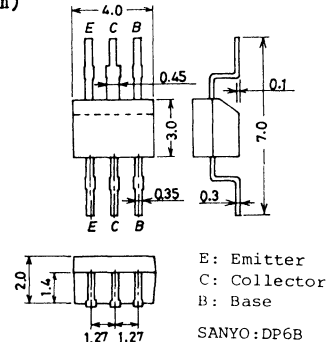
Case Outline 2029A

(unit:mm)

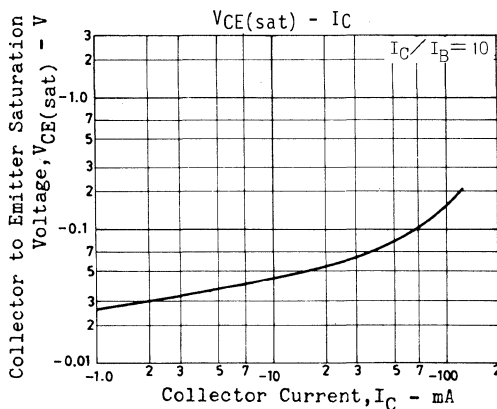
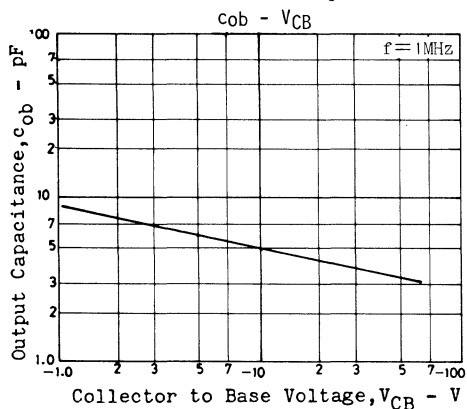
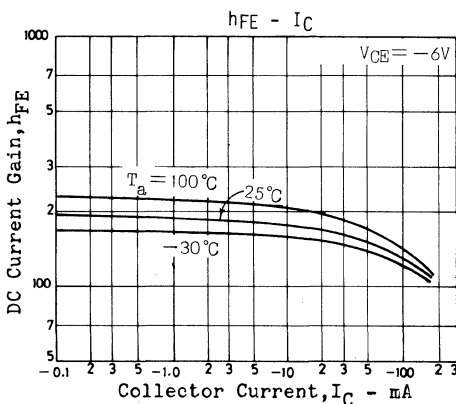
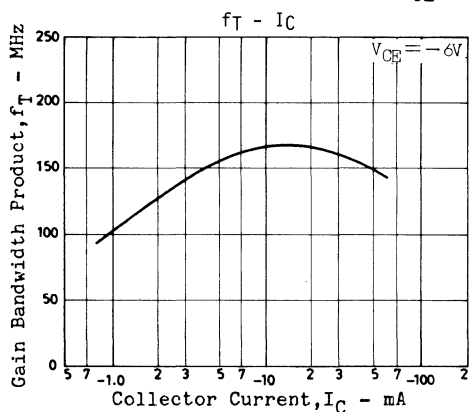
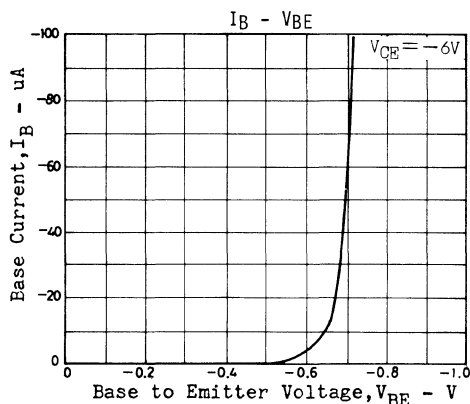
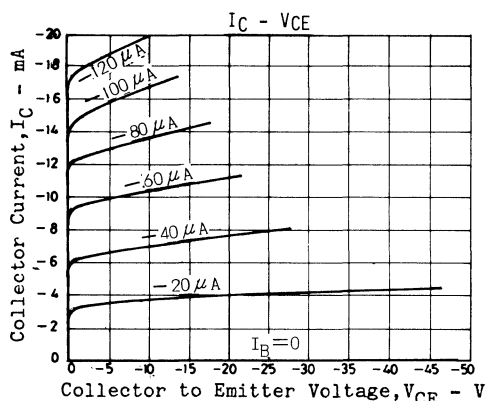


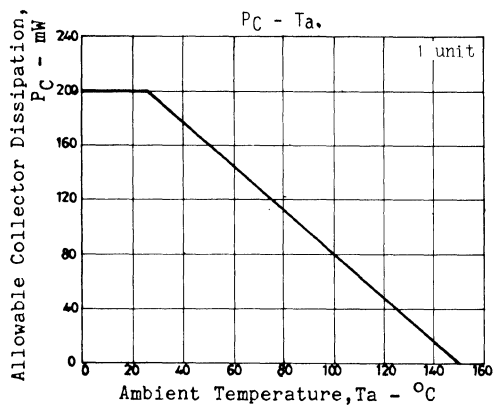
Case Outline 2030A

(unit:mm)



Base to Emitter Voltage Drop	$V_{BE(\text{large/small})}$	$V_{CE} = -6V, I_C = -1mA$	min 1.0	typ 10	max 10	unit mV
Collector to Emitter Saturation Voltage	$V_{CE(\text{sat})}$	$I_C = -50mA, I_B = -5mA$			-0.5	V
Gain Bandwidth Product	f_T	$V_{CE} = -6V, I_C = -1mA$		100		MHz
Output Capacitance	c_{ob}	$V_{CB} = -10V, f = 1MHz$		5.0		pF
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = -10uA, I_E = 0$	-55			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = -1mA, I_{BE} = \infty$	-50			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = -10uA, I_C = 0$	-5			V





2SA1238



2029A



2030A

PNP Epitaxial Planar
Silicon Composite Transistor

Differential Amp Applications

©968B

Applications

- . Differential amp, current mirror.

Features

- . Excellent in thermal equilibrium and suited for use in first-stage differential amp.
- . Low noise.
- . Matched pair capability.

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	-55	V
Collector to Emitter Voltage	V_{CE0}	-50	V
Emitter to Base Voltage	V_{EB0}	-5	V
Collector Current	I_C	-150	mA
Peak Collector Current	i_{cp}	-300	mA
Collector Dissipation	P_C	200	mW
Total Dissipation	P_T	400	mW
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

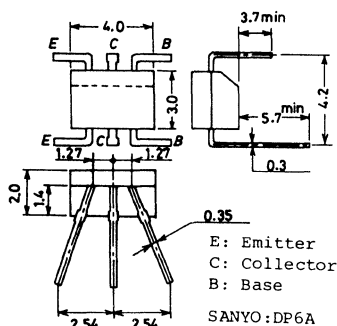
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=-35\text{V}, I_E=0$			-0.1	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=-4\text{V}, I_C=0$			-0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=-6\text{V}, I_C=-1\text{mA}$	100		560	
DC Current Gain Ratio	$h_{FE(\text{small}/\text{large})}$	$V_{CE}=-6\text{V}, I_C=-1\text{mA}$	0.85	0.98		

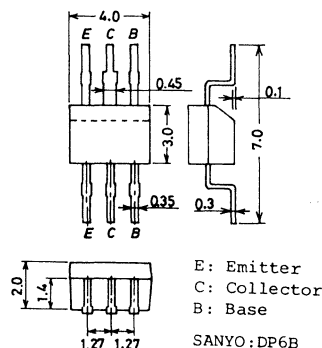
* The 2SA1238 is classified by h_{FE} (small) as follows:

100	E	200	160	F	320	280	G	560
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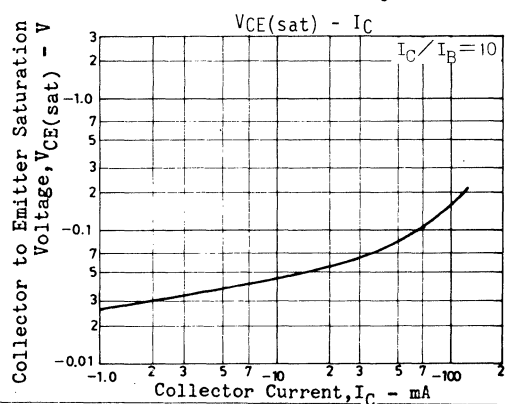
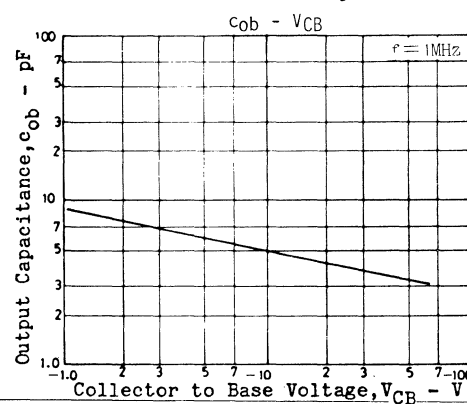
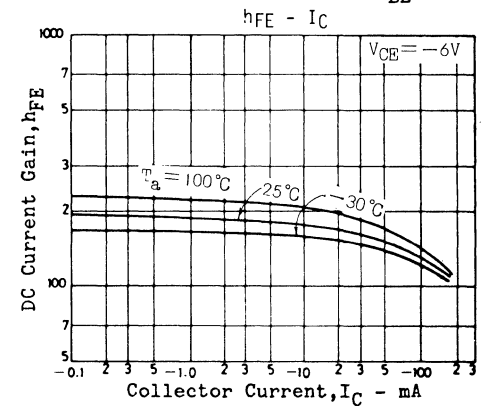
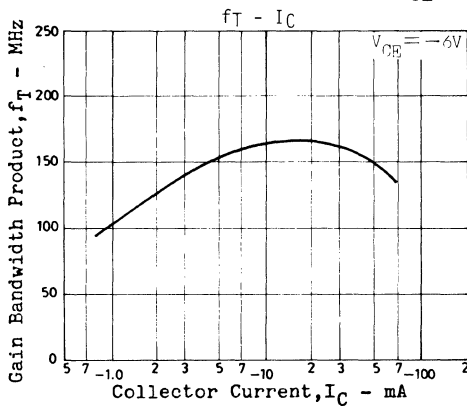
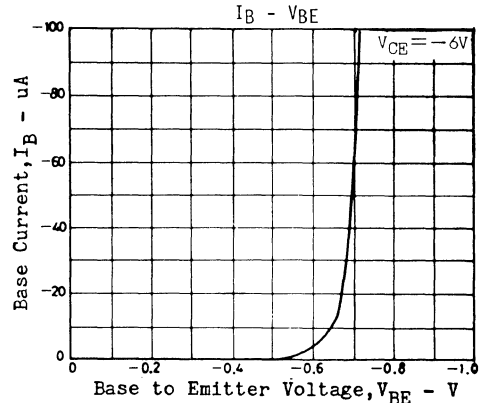
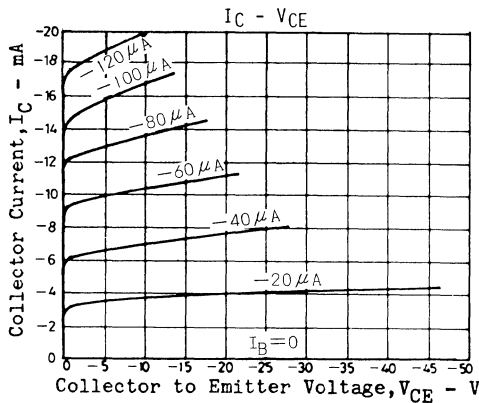
Case Outline 2029A (unit:mm)

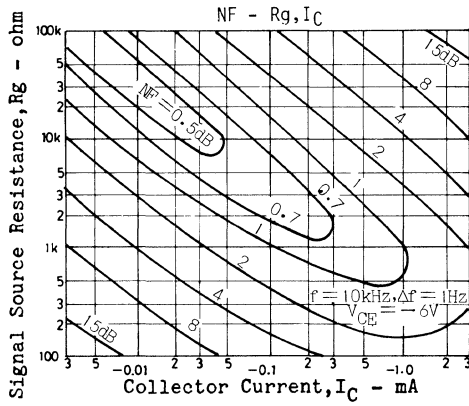
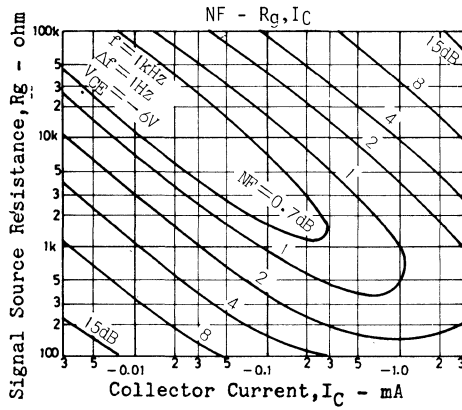
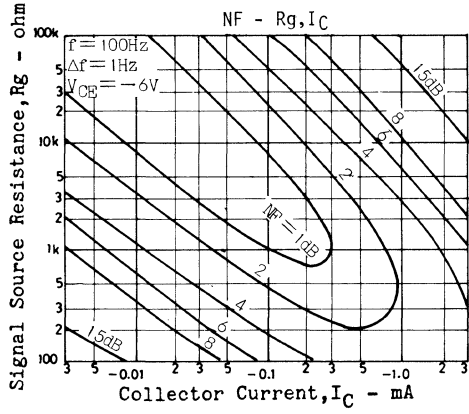
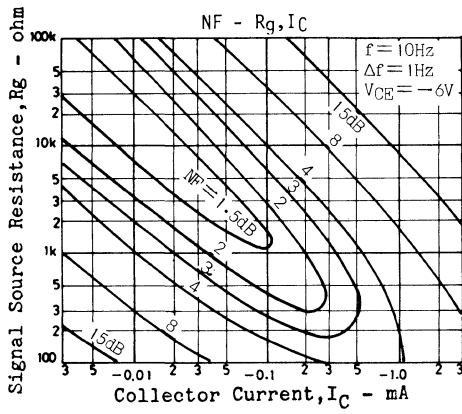


Case Outline 2030A (unit:mm)



Base to Emitter Voltage Drop	$V_{BE(\text{large/small})}$	$V_{CE} = -6V, I_C = -1mA$	min 1.0	typ 10	max 10	unit mV
Collector to Emitter Saturation Voltage	$V_{CE(\text{sat})}$	$I_C = -50mA, I_B = -5mA$			-0.5	V
Gain Bandwidth Product	f_T	$V_{CE} = -6V, I_C = -1mA$		100		MHz
Output Capacitance	c_{ob}	$V_{CB} = -10V, f = 1MHz$		5.0		pF
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = -10uA, I_E = 0$	-55			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = -1mA, I_{BE} = \infty$	-50			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = -10uA, I_C = 0$	-5			V
Noise Level	$V_{NO(\text{ave})}$	$V_{CC} = 30V, I_C = 1mA,$ $R_g = 56k\Omega, V_G = 77dB/1kHz$			35	mV
Noise Peak Level	$V_{NO(\text{peak})}$	$V_{CC} = 30V, I_C = 1mA,$ $R_g = 56k\Omega, V_G = 77dB/1kHz$			200	mV





2SA1239



2029A



2030A

PNP Epitaxial Planar
Silicon Composite Transistor

Differential Amp Applications

©975B

Applications

- . Differential amp, current mirror, temperature compensator.

Features

- . Excellent in thermal equilibrium and suited for use in first-stage differential amp.
- . Matched pair capability.

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	-130	V
Collector to Emitter Voltage	V_{CE0}	-120	V
Emitter to Base Voltage	V_{EB0}	-5	V
Collector Current	I_C	-50	mA
Peak Collector Current	i_{cp}	-100	mA
Collector Dissipation	P_C	200	mW
Total Dissipation	P_T	400	mW
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

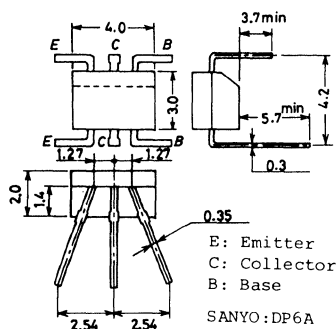
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=-80\text{V}, I_E=0$			-0.1	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=-4\text{V}, I_C=0$			-0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=-6\text{V}, I_C=-1\text{mA}$	160		560	
DC Current Gain Ratio	$h_{FE(\text{small/large})}$	$V_{CE}=-6\text{V}, I_C=-1\text{mA}$	0.85	0.98		

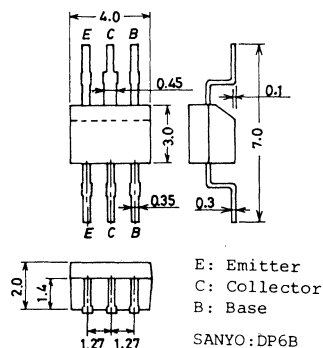
* The 2SA1239 is classified by h_{FE} (small) as follows:

160	F	320	280	G	560
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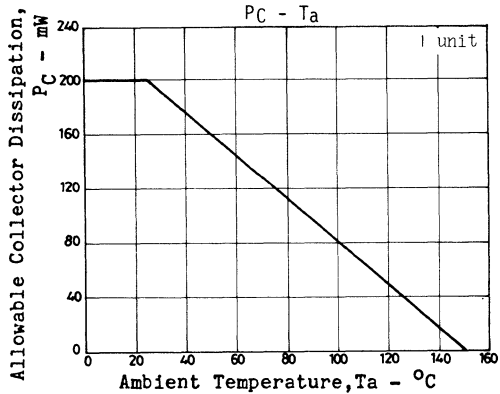
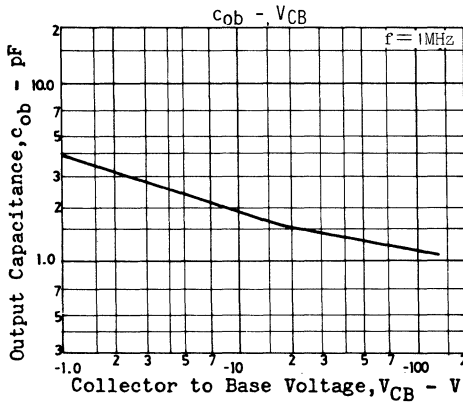
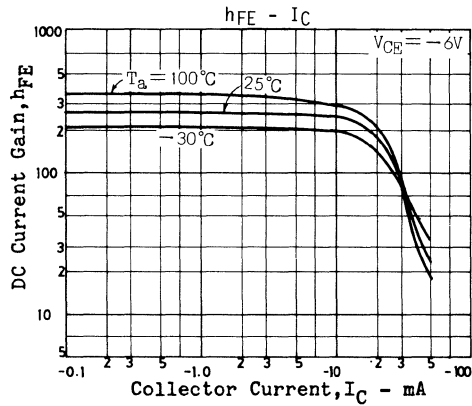
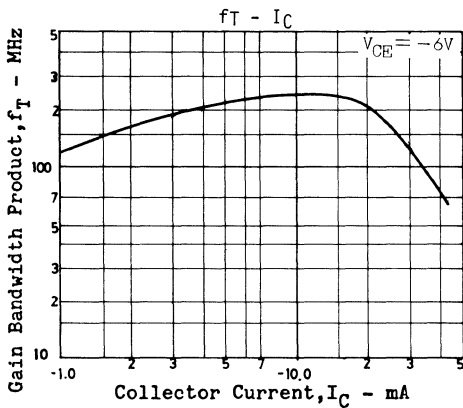
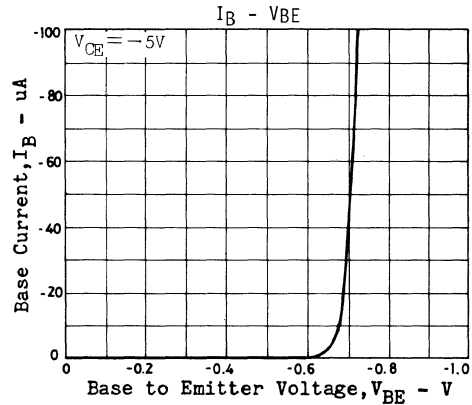
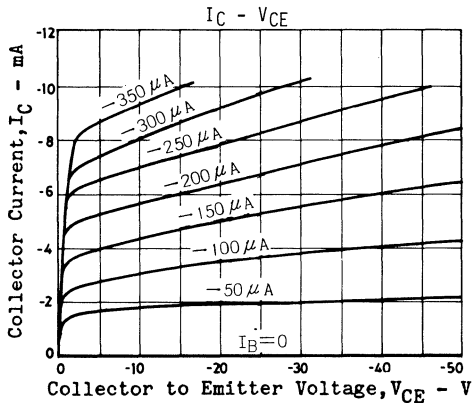
Case Outline 2029A
(unit:mm)



Case Outline 2030A
(unit:mm)



			min	typ	max	unit
Base to Emitter Voltage Drop	$V_{BE(\text{large/small})}$	$V_{CE} = -6V, I_C = -1mA$		1.0	10	mV
Collector to Emitter Saturation Voltage	$V_{CE(\text{sat})}$	$I_C = -10mA, I_B = -1mA$			-0.5	V
Gain Bandwidth Product	f_T	$V_{CE} = -6V, I_C = -1mA$		110		MHz
Output Capacitance	c_{ob}	$V_{CB} = -10V, f = 1MHz$		2.0		pF
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = -10\mu A, I_E = 0$	-130			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = -1mA, I_{BE} = \infty$	-120			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = -10\mu A, I_C = 0$	-5			V



2SA1240



2029A



2030A

PNP Epitaxial Planar
Silicon Composite Transistor

Differential Amp Applications

©977B

Applications

- . Differential amp, current mirror.

Features

- . Excellent in thermal equilibrium and suited for use in first-stage differential amp.
- . Low noise.
- . Matched pair capability.

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	-130	V
Collector to Emitter Voltage	V_{CE0}	-120	V
Emitter to Base Voltage	V_{EB0}	-5	V
Collector Current	I_C	-50	mA
Peak Collector Current	i_{cp}	-100	mA
Collector Dissipation	P_C	200	mW
Total Dissipation	P_T	400	mW
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

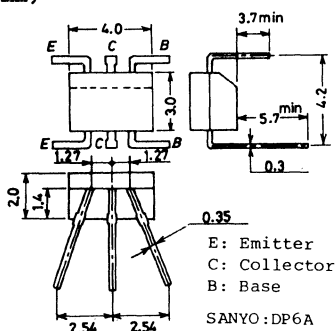
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=-80\text{V}, I_E=0$			-0.1	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=-4\text{V}, I_C=0$			-0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=-6\text{V}, I_C=-1\text{mA}$	160		560	
DC Current Gain Ratio	$h_{FE(\text{small}/\text{large})}$	$V_{CE}=-6\text{V}, I_C=-1\text{mA}$	0.85	0.98		

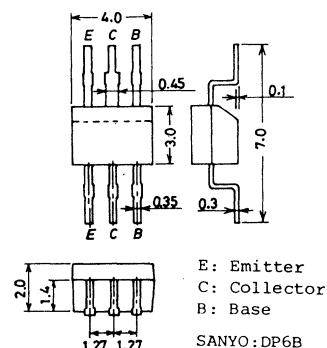
* The 2SA1240 is classified by h_{FE} (small) as follows:

160	F	320	280	G	560
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Case Outline 2029A
(unit:mm)

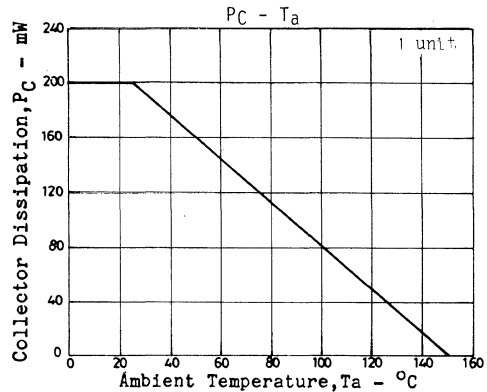
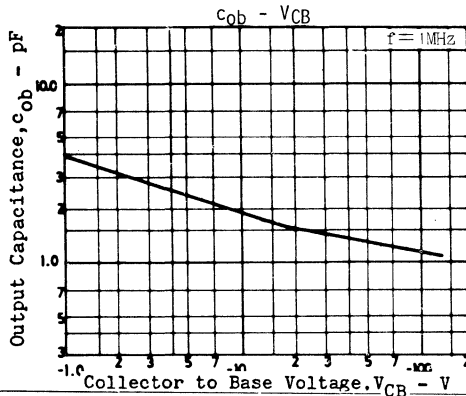
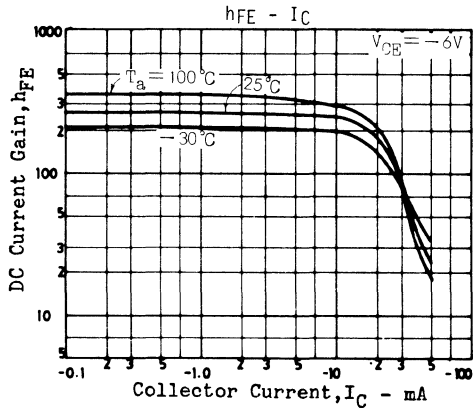
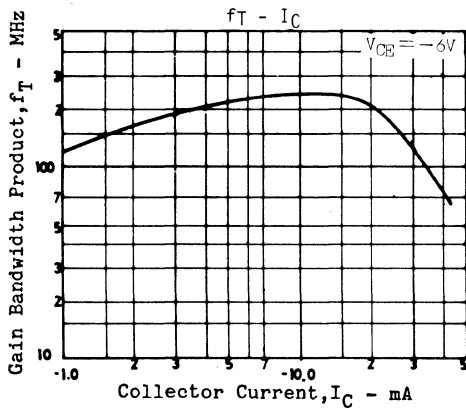
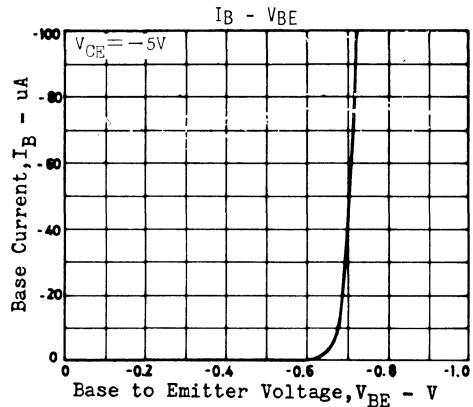
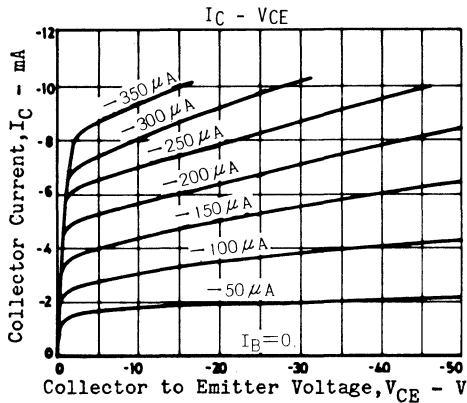


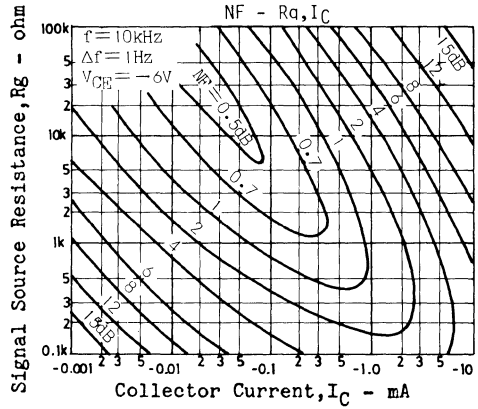
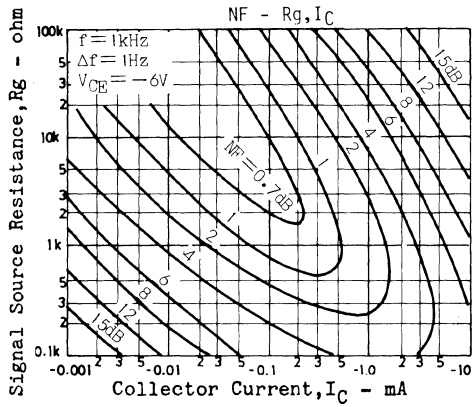
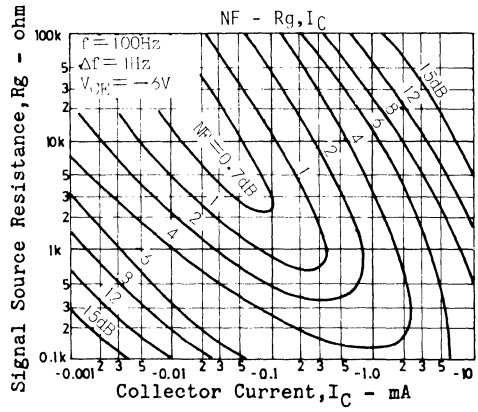
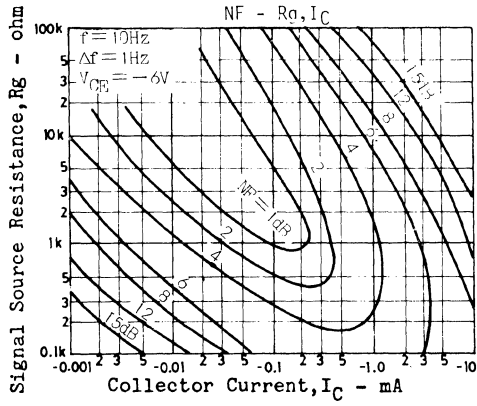
Case Outline 2030A
(unit:mm)



2SA1240

			min	typ	max	unit
Base to Emitter Voltage Drop	$V_{BE(\text{large/small})}$	$V_{CE} = -6V, I_C = -1mA$		1.0	.10	mV
Collector to Emitter Saturation Voltage	$V_{CE(\text{sat})}$	$I_C = -10mA, I_B = -1mA$			-0.5	V
Gain Bandwidth Product	f_T	$V_{CE} = -6V, I_C = -1mA$		110		MHz
Output Capacitance	c_{ob}	$V_{CB} = -10V, f = 1MHz$		2.0		pF
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = -10uA, I_E = 0$	-130			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = -1mA, I_{BE} = \infty$	-120			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = -10uA, I_C = 0$	-5			V
Noise Level	$V_{NO(\text{ave})}$	$V_{CC} = 30V, I_C = 1mA, R_g = 56k\Omega, V_G = 77dB/1kHz$			35	mV
Noise Peak Level	$V_{NO(\text{peak})}$	$V_{CC} = 30V, I_C = 1mA, R_g = 56k\Omega, V_G = 77dB/1kHz$			200	mV





2SA1246



2003A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3114

Low Frequency, General-Purpose Amp Applications

©1047A

Features

- High V_{EBO}
- Wide ASO and highly resistant to breakdown

(): 2SA1246

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Collector to base voltage	V_{CBO}	(-)60	V
Collector to emitter voltage	V_{CEO}	(-)50	V
Emitter to base voltage	V_{EBO}	(-)15	V
Collector current	I_C	(-)150	mA
Peak collector current	i_{cp}	(-)300	mA
Collector dissipation	P_C	400	mW
Junction temperature	T_j	150	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ~ +150	$^\circ\text{C}$

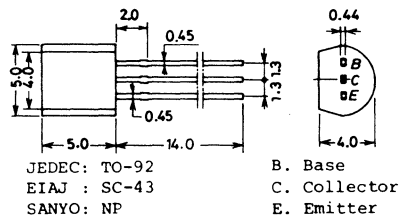
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB}=(-)40\text{ V}, I_E=0$			(-)0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB}=(-)10\text{ V}, I_C=0$			(-)0.1	μA
DC current gain	h_{FE}	$V_{CE}=(-)6\text{ V}, I_C=(-)1\text{ mA}$	100*		560*	
Gain bandwidth product	f_T	$V_{CE}=(-)6\text{ V}, I_C=(-)1\text{ mA}$		100		MHz
Common base output capacitance	c_{ob}	$V_{CB}=(-)6\text{ V}, f=1\text{ MHz}$		3.0		pF
C-E saturation voltage	$V_{CE(sat)}$	$I_C=(-)50\text{ mA}, I_B=(-)5\text{ mA}$		(4.2)	(-)0.5	V
C-B breakdown voltage	$V_{(BR)CBO}$	$I_C=(-)10\text{ }\mu\text{A}, I_E=0$	(-)60			V
C-E breakdown voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{ mA}, R_{BE}=\infty$	(-)50			V
E-B breakdown voltage	$V_{(BR)EBO}$	$I_E=(-)10\text{ }\mu\text{A}, I_C=0$	(-)15			V

* The 2SA1246/2SC3114 are classified as follows according to h_{FE} at 1 mA.

100	R	200	140	S	280	200	T	400	280	U	560
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Case Outline 2003A
(unit: mm)



For details, refer to the description of the 2SC3114.

2SA1248



2009

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3116

High Voltage Switchng Applications

©1032

Uses

- Color TV sound output, converters, inverters

Features

- High breakdown voltage
- Large current capacity
- Using MBIT process

(): 2SA1248

Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-) 180	V
Collector to Emitter Voltage	V_{CEO}	(-) 160	V
Emitter to Base Voltage	V_{EBO}	(-) 6	V
Collector Current	I_C	(-) 0.7	A
Peak Collector Current	i_{cp}	(-) 1.5	A
Collector Dissipation	P_C	1	W
	$T_c=25^{\circ}\text{C}$	10	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to $+150$	$^{\circ}\text{C}$

Electrical Characteristics/ $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)120\text{V}, I_E=0$			(-) 1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-) 1.0	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=(-)5\text{V}, I_C=(-)100\text{mA}$	100^*		400^*	
	$h_{FE}(2)$	$V_{CE}=(-)5\text{V}, I_C=(-)10\text{mA}$	90			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		120		MHz
Common Base Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		8		pF
				(11)		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)250\text{mA}, I_B=(-)25\text{mA}$		0.12	0.4	V
				(-) 0.2	(-) 0.5	
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)250\text{mA}, I_B=(-)25\text{mA}$		(-) 0.85	(-) 1.2	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-) 180			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	(-) 160			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$	(-) 6			V
Turn-on Time	t_{on}	at Specified Test Circuit		(60)50		ns
Storage Time	t_{stg}	"		(900)1000		ns
Fall Time	t_f	"		(60)60		ns

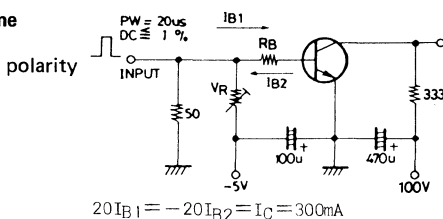
* The 2SA1248/2SC3116 are classified as follows according to h_{FE} at 100mA.

100	R	200	140	S	280	200	T	400
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Switching Time

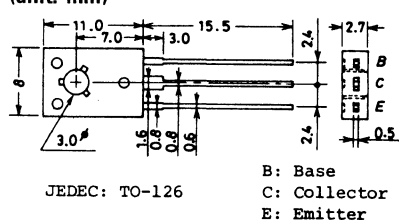
Test Circuit

(polarity is reversed.)



Case Outline 2009

(unit: mm)



B: Base
C: Collector
E: Emitter

For details, refer to the description of the 2SC3116.

2SA1249



2009

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3117

High Voltage Switching Applications

(E)1060

Uses

- Color TV sound output, converters, inverters

Features

- High breakdown voltage
- Large current capacity
- Using MBIT process

(): 2SA1249

Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)180	V
Collector to Emitter Voltage	V_{CEO}	(-)160	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)1.5	A
Peak Collector Current	i_{cp}	(-)2.5	A
Collector Dissipation	P_C	1	W
	$T_c=25^{\circ}\text{C}$	10	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics/ $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)120\text{V}, I_E=0$			(-)1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)1.0	μA
Common Emitter DC Current Gain	$h_{FE}(1)$	$V_{CE}=(-)5\text{V}, I_C=(-)100\text{mA}$	100*		400*	
	$h_{FE}(2)$	$V_{CE}=(-)5\text{V}, I_C=(-)10\text{mA}$	90			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		120		MHz
Common Base Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(22)		pF
				14		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500\text{mA}, I_B=(-)50\text{mA}$		(-0.2)	(-0.5)	V
				0.13	0.45	
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500\text{mA}, I_B=(-)50\text{mA}$		(-)0.85	(-)1.2	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$		(-)180		V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$		(-160		V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$		(-)6		V
Turn-on Time	t_{on}	at Specified Test Circuit		0.04		μs
Storage Time	t_{stg}	"		(0.7)1.2		μs
Fall Time	t_f	"		(0.04)0.08		μs

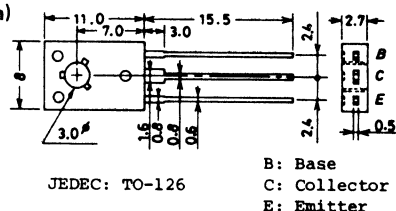
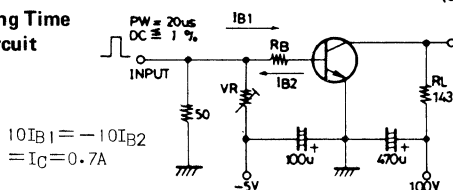
* The 2SA1249/2SC3117 are classified as follows according to h_{FE} at 100mA.

100	R	200	140	S	280	200	T	400
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Case Outline 2009

(unit: mm)

Switching Time Test Circuit



For details, refer to the description of the 2SC3117.

2SA1252



2018

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3134

Low Frequency, General-Purpose Amp Applications

©1048A

Features

- . High V_{EBO} .
- . Wide ASO and high durability against breakdown.

() : 2SA1252

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

Collector to Base Voltage	V_{CBO}	(-)60	V
Collector to Emitter Voltage	V_{CEO}	(-)50	V
Emitter to Base Voltage	V_{EBO}	(-)15	V
Collector Current	I_C	(-)150	mA
Peak Collector Current	i_{cp}	(-)300	mA
Collector Dissipation	P_C	200	mW
Junction Temperature	T_j	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +125	$^\circ\text{C}$

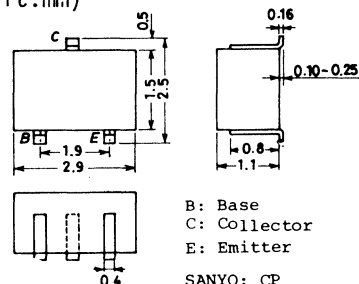
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)10\text{V}, I_C=0$			(-)0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)6\text{V}, I_C=(-)1\text{mA}$	100*		560*	
Gain Bandwidth Product	f_T	$V_{CE}=(-)6\text{V}, I_C=(-)1\text{mA}$		100		MHz
Output Capacitance	C_{ob}	$V_{CB}=(-)6\text{V}, f=1\text{MHz}$		(3.5)		pF
				2.2		
C to E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)50\text{mA}, I_B=(-)5\text{mA}$			(-)0.5	V
C to B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)60			V
C to E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	(-)50			V
E to B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$	(-)15			V

*The 2SA1252/2SC3134 are classified as follows according to h_{FE} at 1mV

2SA1252	90	D4	180	135	D5	270	200	D6	400	300	D7	600
2SC3134	90	H4	180	135	H5	270	200	H6	400	300	H7	600

Case Outline 2018 (unit:mm)



For details, refer to the description of the 2SC3134.

2SA1253



2000B

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3135

Low Frequency, General-Purpose Amp Applications

©1049B

Features

- High V_{EBO}
- Wide ASO and high durability against breakdown

(): 2SA1253

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Collector to base voltage	V_{CBO}	(-)60	V
Collector to emitter voltage	V_{CEO}	(-)50	V
Emitter to base voltage	V_{EBO}	(-)15	V
Collector current	I_C	(-)200	mA
Peak collector current	i_{cp}	(-)400	mA
Collector dissipation	P_C	250	mW
Junction temperature	T_j	150	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ~ +150	$^\circ\text{C}$

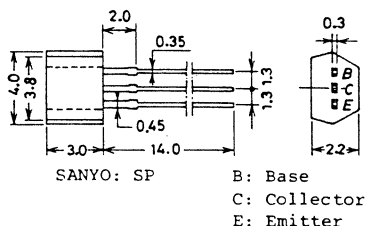
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = (-)40\text{V}, I_E = 0$			(-)0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = (-)10\text{V}, I_C = 0$			(-)0.1	μA
DC current gain	h_{FE}	$V_{CE} = (-)6\text{V}, I_C = (-)1\text{mA}$	100*		560*	
Gain bandwidth product	f_T	$V_{CE} = (-)6\text{V}, I_C = (-)1\text{mA}$		100		MHz
Common base output capacitance	c_{ob}	$V_{CB} = (-)6\text{V}, f = 1\text{MHz}$		(3.8)		pF
				2.5		
Collector to emitter saturation voltage $V_{CE(sat)}$		$I_C = (-)50\text{mA}, I_B = (-)5\text{mA}$		(-0.2)	(-)0.5	V
				0.15		
Collector to base breakdown voltage $V_{(BR)CBO}$		$I_C = (-)10\mu\text{A}, I_E = 0$	(-)60			V
Collector to emitter breakdown voltage $V_{(BR)CEO}$		$I_C = (-)1\text{mA}, R_{BE} = \infty$	(-)50			V
Emitter to base breakdown voltage $V_{(BR)EBO}$		$I_E = (-)10\mu\text{A}, I_C = 0$	(-)15			V

* The 2SA1253/2SC3135 are classified by 1 mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400	280	U	560
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Case Outline 2000B
(unit: mm)



For details, refer to the description of the 2SC3135.

2SA1256

2018

PNP Epitaxial Planar
Silicon Transistor

High Frequency, General-Purpose Amp Applications

©1056A

Use

- Ideally suited for use in FM RF amplifiers, mixers, oscillators, converters, IF amplifiers.

Features

- High f_T (230MHz typ.) and small c_{re} (1.1pF typ.).
- Small NF (2.5dB typ.).

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	-30	V
Collector to Emitter Voltage	V_{CEO}	-20	V
Emitter to Base Voltage	V_{EBO}	-5	V
Collector Current	I_C	-30	mA
Collector Dissipation	P_C	150	mW
Junction Temperature	T_j	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +125	$^\circ\text{C}$

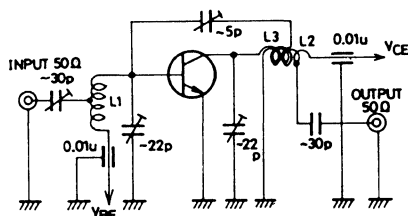
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=-10\text{V}, I_E=0$			-0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=-4\text{V}, I_C=0$			-0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=-6\text{V}, I_C=-1\text{mA}$	60*		270*	
Gain Bandwidth Product	f_T	$V_{CE}=-6\text{V}, I_C=-1\text{mA}$	150	230		MHz
Reverse Transfer Capacitance	c_{re}	$V_{CB}=-6\text{V}, f=1\text{MHz}$		1.1	1.7	pF
B to C Time Constant	$r_{bb'} c_C$	$V_{CB}=-6\text{V}, I_C=-1\text{mA}, f=31.9\text{MHz}$		11	20	ps
Noise Figure	NF	$V_{CE}=-6\text{V}, I_C=-1\text{mA}, f=100\text{MHz}$		2.5		dB
Power Gain	PG	$V_{CE}=-6\text{V}, I_C=-1\text{mA}, f=100\text{MHz}$		22		dB

* The 2SA1256 is classified by 1mA h_{FE} follows:

60	E3	120	90	E4	180	135	E5	270
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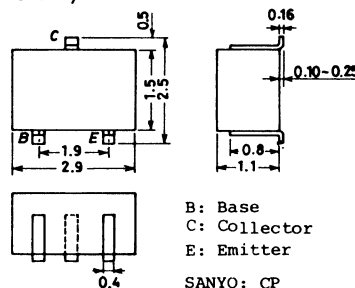
NF, PG Test Circuit

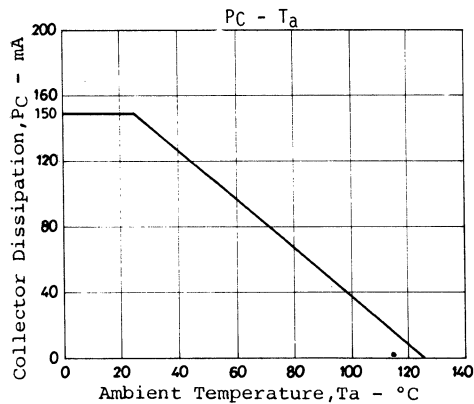
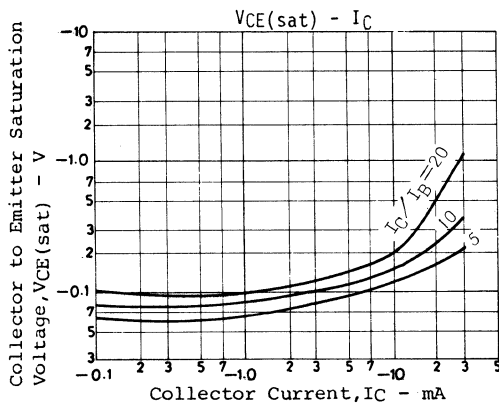
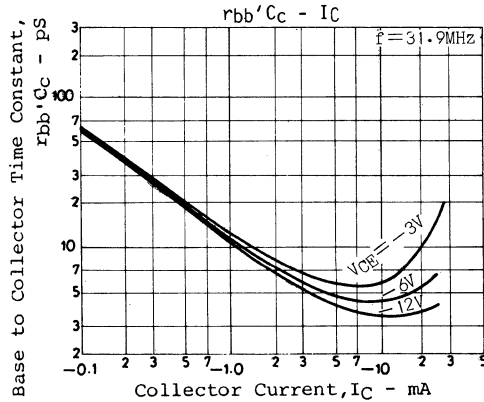
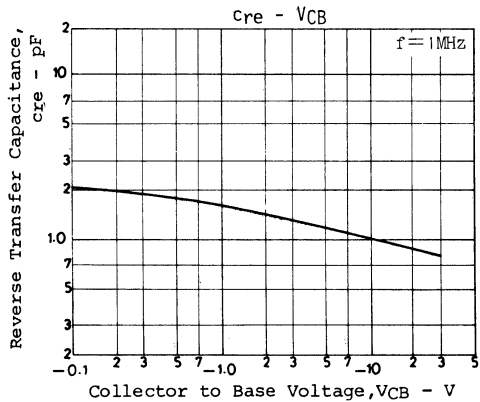
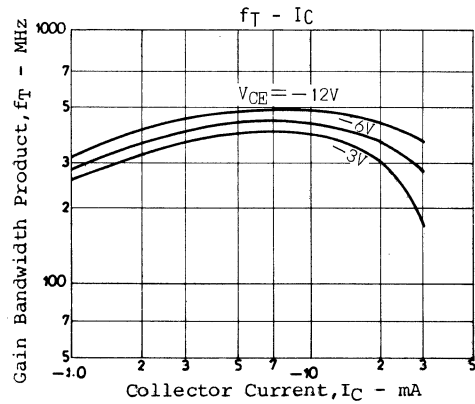
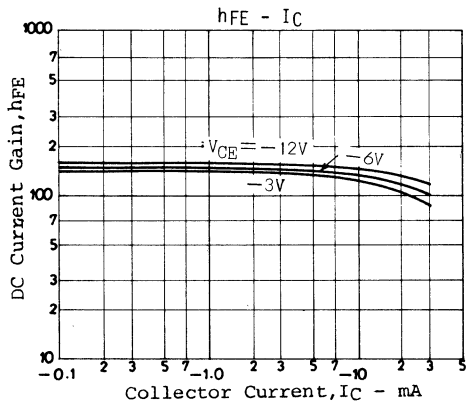
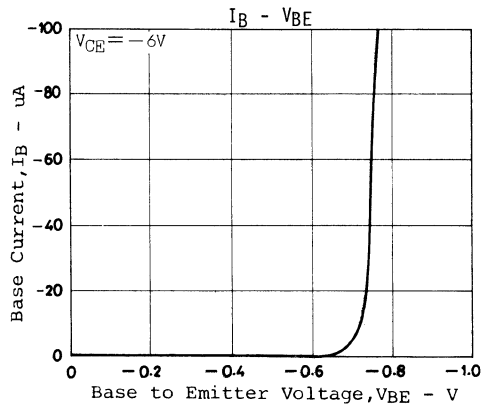
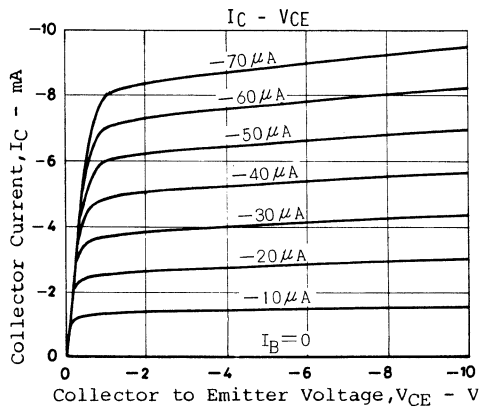


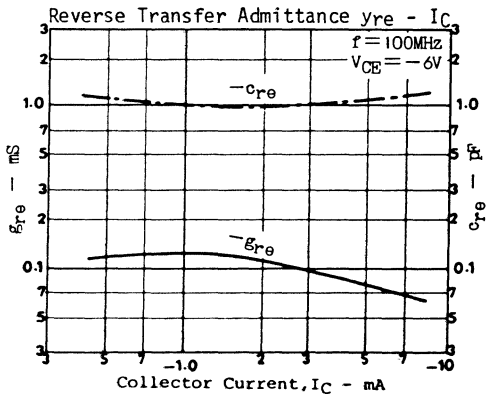
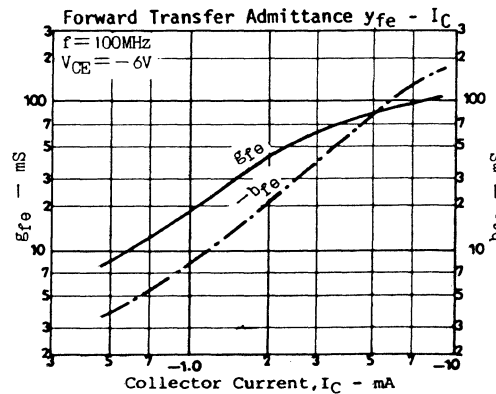
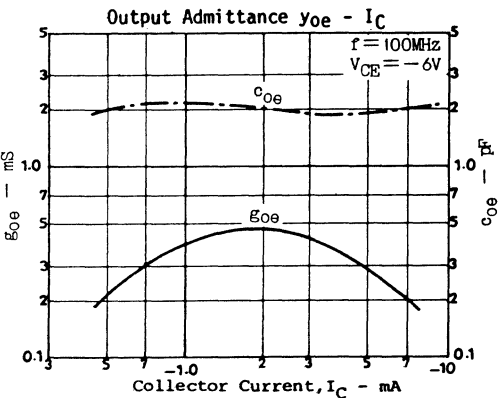
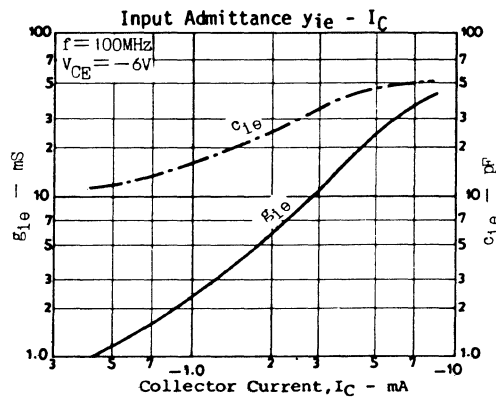
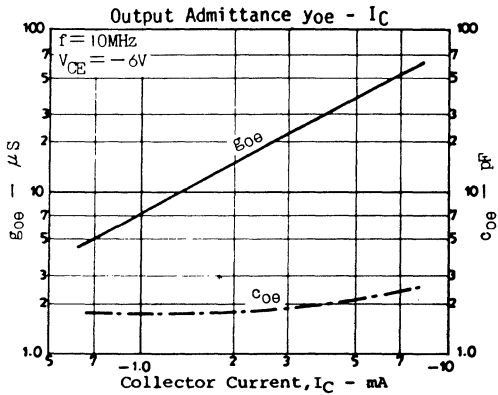
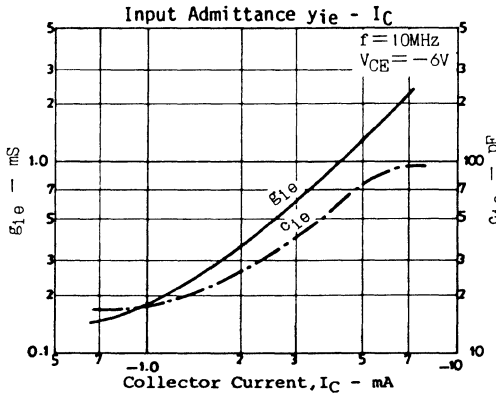
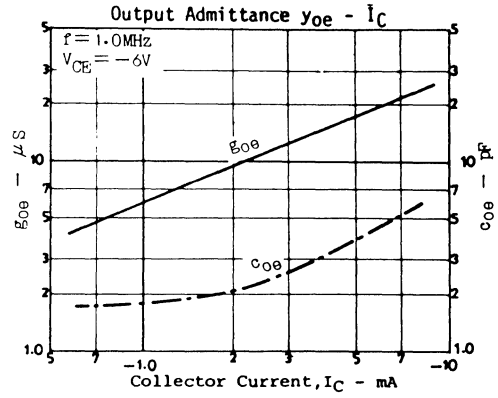
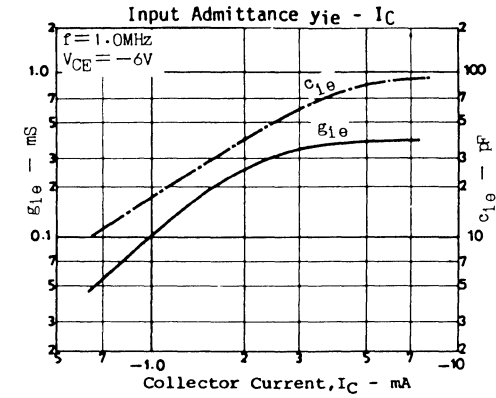
L1: 1mm ϕ plated wire 10mm ϕ 5T, tap: 2T from V_{BE} side
L2: 1mm ϕ plated wire 10mm ϕ 7T, tap: 1T from V_{CE} side
L3: 1mm ϕ enameled wire 10mm ϕ 3T

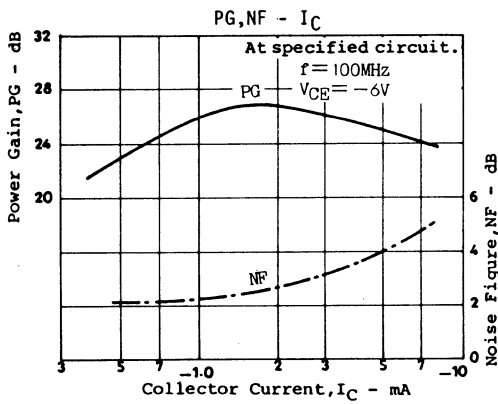
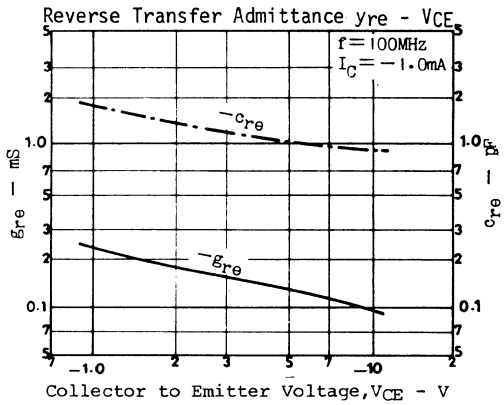
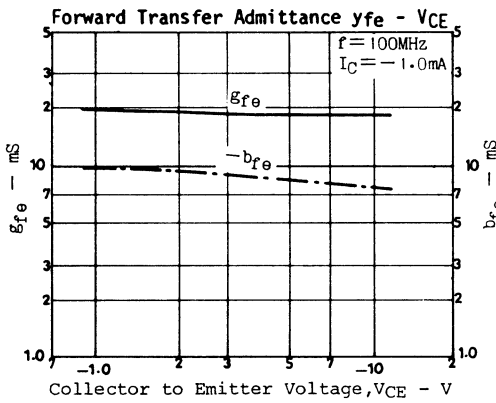
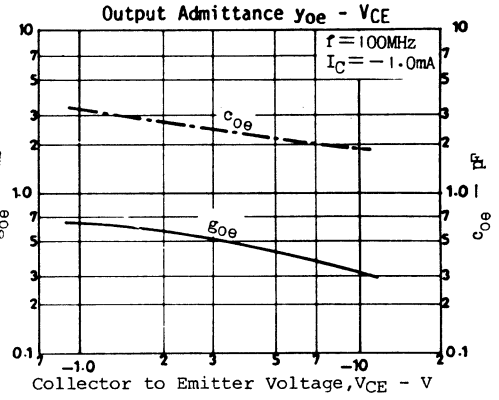
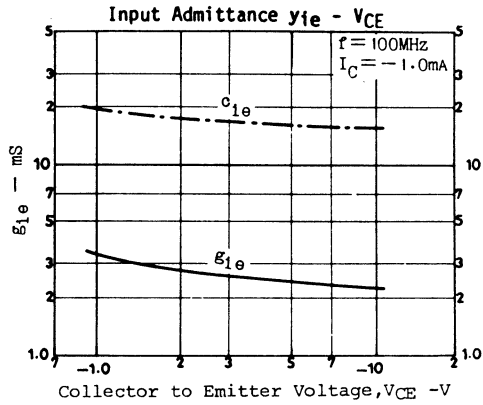
Note) For characteristics, refer to the catalog of the 2SA1177.

Case Outline 2018 (unit:mm)









2SA1257



2018

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3143

High Voltage Switching, AF 100W Predriver Applications

©1057

Features:

- Very small package enabling compactness and slimness of sets
- High breakdown voltage ($V_{CEO} \geq 160V$)
- Small output capacitance

(): 2SA1257

Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	(-)180	V
Collector to Emitter Voltage	V_{CEO}	(-)160	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)80	mA
Peak Collector Current	i_{co}	(-)150	mA
Collector Dissipation	P_C	200	mW
Junction Temperature	T_j	125	$^\circ C$
Storage Temperature	T_{stg}	-55 to +125	$^\circ C$

Electrical Characteristics at $T_a = 25^\circ C$

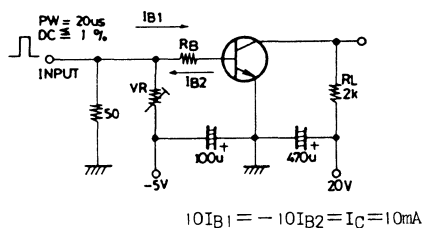
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-)120V, I_E = 0$			(-)0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$			(-)0.1	μA
DC Current Gain	h_{FE}	$V_{CE} = (-)5V, I_C = (-)10mA$	60*		270*	
Gain Bandwidth Product	f_T	$V_{CE} = (-)10V, I_C = (-)10mA$		(130)		MHz
				150		
Output Capacitance	c_{ob}	$V_{CB} = (-)10V, f = 1MHz$		(2.4)	(3.2)	pF
				2.0	2.8	
Base to Emitter Voltage	V_{BE}	$V_{CE} = (-)5V, I_C = (-)10mA$			(-)1.5	V
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-)30mA, I_B = (-)3mA$			(-)0.7	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-)10\mu A, I_E = 0$			(-)180	V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$			(-)160	V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-)10\mu A, I_C = 0$			(-)5	V
Rise Time	t_{on}	[at specified test circuit]		(0.15)	0.18	μs
Storage Time	t_{stg}			(0.95)	1.00	μs
Fall Time	t_f			(0.15)	0.20	μs

*: The 2SA1257/2SC3143 are classified by 10mA h_{FE} as follows.

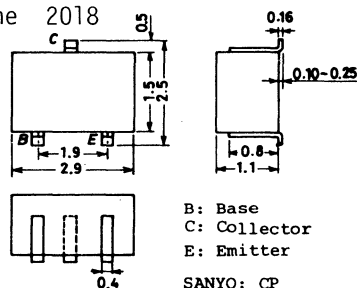
2SA1257	60	G3	120	90	G4	180	135	G5	270
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2SC3143	60	K3	120	90	K4	180	135	K5	270
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Switching Time Test Circuit

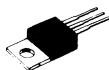


Case Outline 2018 (unit:mm)



For details, refer to the description of the 2SC3143.

2SA1258



2010A

PNP/NPN Epitaxial Planar
Silicon Darlington Transistors

2SC3144

High Speed Driver Applications

©1058A

Features

- High f_T
- High switching speed
- Wide ASO

(): 2SA1258

Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

		unit
Collector to Base Voltage	V_{CBO}	(-) 70 V
Collector to Emitter Voltage	V_{CEO}	(-) 60 V
Emitter to Base Voltage	V_{EBO}	(-) 5 V
Collector Current	I_C	(-) 3 A
Peak Collector Current	i_{cp}	(-) 5 A
Collector Dissipation	P_C	1.75 W
	$T_c=25^\circ\text{C}$	20 W
Junction Temperature	T_j	150 $^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to $+150$ $^\circ\text{C}$

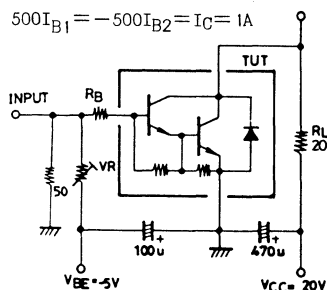
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			(-) 0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$			(-) 3	mA
Common Emitter DC Current Gain	h_{FE}	$V_{CE}=(-)2\text{V}, I_C=(-)1.5\text{A}$	2000	5000		
Gain Band-width Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1.5\text{A}$		200		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)1.5\text{A}, I_B=(-)3\text{mA}$		(-) 1.0	(-) 1.5	V
				0.9		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)1.5\text{A}, I_B=(-)3\text{mA}$			(-) 2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-) 70			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-) 60			V
Turn-on Time	t_{on}	at Specified Test Circuit		0.3		μs
Storage Time	t_{stg}	"		(1.3)		μs
				1.2		
Fall Time	t_f	"		0.2		μs

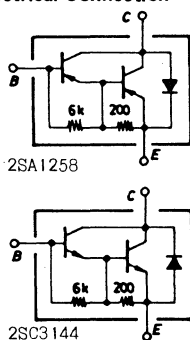
Specified Test Circuit
(For PNP, the polarity is reversed.)

$PW=50\mu\text{s}, \text{Duty Cycle} \leq 1\%$

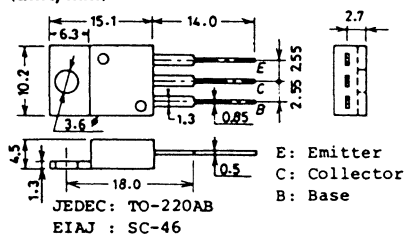
$500I_{B1} = -500I_{B2} = I_C = 1\text{A}$



Electrical Connection

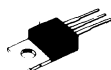


Case Outline 2010A (unit: mm)



For details, refer to the description of the 2SC3144.

2SA1259



2010A

PNP/NPN Epitaxial Planar
Silicon Darlington Transistors

2SC3145

High Speed Driver Applications

©1059A

Features

- High f_T
- High switching speed
- Wide ASO

(): 2SA1259

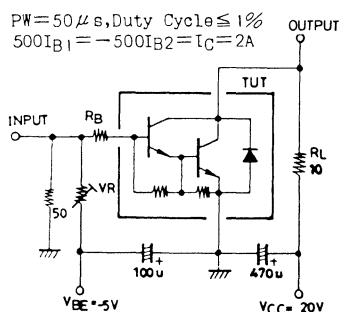
Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-) 70	V
Collector to Emitter Voltage	V_{CE0}	(-) 60	V
Emitter to Base Voltage	V_{EB0}	(-) 5	V
Collector Current	I_C	(-) 5	A
Peak Collector Current	i_{cp}	(-) 8	A
Collector Dissipation	P_C	1.75	W
	$T_C=25^\circ\text{C}$	30	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to $+150$	$^\circ\text{C}$

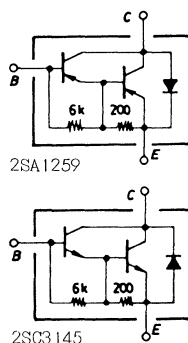
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			(-) 0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$			(-) 3	mA
Common Emitter DC Current Gain	h_{FE}	$V_{CE}=(-)2\text{V}, I_C=(-)2.5\text{A}$	2000	5000		
Gain Band-width Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)2.5\text{A}$		200		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)2.5\text{A}, I_B=(-)5\text{mA}$		(-) 1.0	(-) 1.5	V
				0.9		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)2.5\text{A}, I_B=(-)5\text{mA}$			(-) 2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-) 70			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-) 60			V

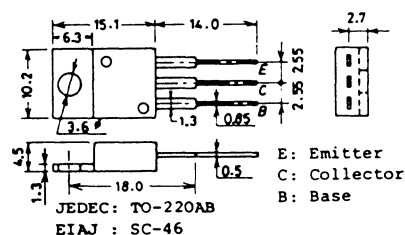
Specified Test Circuit
(For PNP, the polarity is reversed.)



Electrical Connection

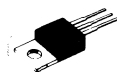


Case Outline 2010A (unit; mm)



For details, refer to the description of the 2SC3145.

2SA1289



2010A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3253

High Current Switching Applications

©1199

Applications

- . Various inductance lamp drivers for electrical equipment.
- . Inverters, converters (strobo, flash, fluorescent lamp lighting circuit).
- . Power amp. (high power car stereo, motor controller).
- . High-speed switching (switching regulator, driver).

Features

- . Low saturation voltage.
- . Excellent current dependence of h_{FE} .
- . Short switching time.

(): 2SA1289

Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)80	V
Collector to Emitter Voltage	V_{CEO}	(-)60	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)5	A
Peak Collector Current	i_{cp}	(-)7	A
Collector Dissipation	P_C	30	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

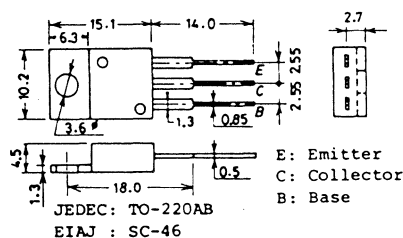
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	mA
DC Current Gain	h_{FE}^*	$V_{CE}=(-)2\text{V}, I_C=(-)1\text{A}$	70*		280*	
Gain Bandwidth Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$		100		MHz

* The 2SA1289/2SC3253 are classified by 1A h_{FE} as follows:

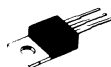
70	Q	140	100	R	200	140	S	280
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Case Outline 2010A (unit:mm)



For details, refer to the description of the 2SC3253.

D064MY, TS No.1199-1/3



2010A

PNP/NPN Epitaxial Planar Silicon Transistors

2SC3254

High Current Switching Applications

©1200

Applications

- Various inductance lamp drivers for car applications.
- Inverters, converters (strobo, flash, fluorescent lamp lighting circuit).
- Power amp (high power car stereo, motor controller).
- High-speed switching (switching regulator, driver).

Features

- Low saturation voltage.
- Excellent current dependence of h_{FE} .
- Short switching time

(): 2SA1290

Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$

Absolute Maximum Ratings/T _a =25°C			unit
Collector to Base Voltage	V _{CB0}	(-)80	V
Collector to Emitter Voltage	V _{CEO}	(-)60	V
Emitter to Base Voltage	V _{EB0}	(-)5	V
Collector Current	I _C	(-)7	A
Peak Collector Current	i _{cp}	(-)10	A
Collector Dissipation	P _C	35	W
Junction Temperature	T _j	150	°C
Storage Temperature	T _{stg}	-55 to +150	°C

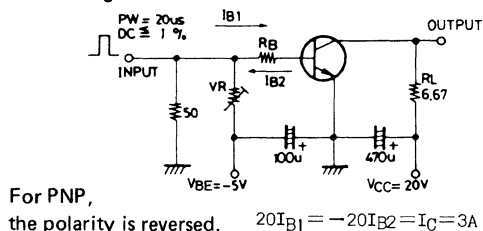
Electrical Characteristics/ $T_a=25^{\circ}\text{C}$

Electrical Characteristics/T _a =25°C			min	typ	max	unit
Collector Cutoff Current	I _{CBO}	V _{CB} =(-)40V, I _E =0			(-)0.1	mA
Emitter Cutoff Current	I _{EBO}	V _{EB} =(-)4V, I _C =0			(-)0.1	mA
DC Current Gain	h _{FE} *	V _{CE} =(-)2V, I _C =(-)1A	70*		280*	
Gain Band-width product	f _T	V _{CE} =(-)5V, I _C =(-)1A		100		MHz
Collector to Emitter Saturation Voltage	V _{CE(sat)}	I _C =(-)3.5A, I _B =(-)0.175A			(-)0.4	V
Collector to Base Breakdown Voltage	V _{(BR)CBO}	I _C =(-)1mA, I _E =0	(-)80			V
Collector to Emitter Breakdown Voltage	V _{(BR)CEO}	I _C =(-)1mA, R _{BE} =∞	(-)60			V
Emitter to Base Breakdown Voltage	V _{(BR)EBO}	I _E =(-)1mA, I _C =0	(-)5			V
Turn-on Time	t _{on}	at specified test circuit		0.1		μs
Storage Time	t _{stg}	"		0.5		μs
Fall Time	t _f	"		0.1		μs

*The 2SA1290/2SC3254 are classified by 1A hFE as follows:

70	Q	140	100	R	200	140	S	280
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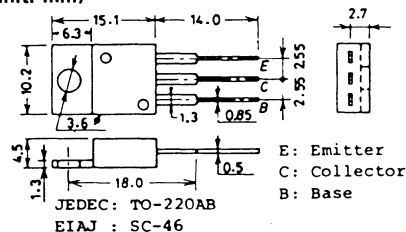
Switching Time Test Circuit



For PNP,
the polarizability

Case Outline 2010A

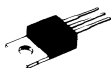
(unit: mm)



For details, refer to the description of the 2SC3254.

0183KI/TS川 No. 1200-1/3

2SA1291



2010A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3255

High Current Switching Applications

(E)1201

Applications

- Various inductance lamp drivers for car applications.
- Inverters, converters (strobo, flash, fluorescent lamp lighting circuit).
- Power amp (high power car stereo, motor controller).
- High-speed switching (switching regulator, driver).

Features

- Low saturation voltage.
- Excellent current dependence of h_{FE} .
- Short switching time

(): 2SA1291

Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)80	V
Collector to Emitter Voltage	V_{CEO}	(-)60	V
Emitter to Base Voltage	V_{EBO}	(-)15	V
Collector Current	I_C	(-)10	A
Peak Collector Current	i_{cp}	(-)12	A
Collector Dissipation	P_C	$T_C=25^\circ\text{C}$ 40	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

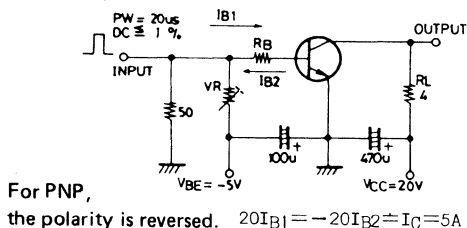
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	mA
DC Current Gain	f_{FE}^*	$V_{CE}=(-)2\text{V}, I_C=(-)1\text{A}$	70*		280*	
Gain Band-width product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$		100		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{A}, I_B=(-)0.25\text{A}$			(-)0.4	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)1\text{mA}, I_E=0$	(-)80			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	(-)60			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)1\text{mA}, I_C=0$	(-)5			V
Turn-on Time	t_{on}	at specified test circuit		0.1		μs
Storage Time	t_{stg}	"		0.5		μs
Fall Time	t_f	"		0.1		μs

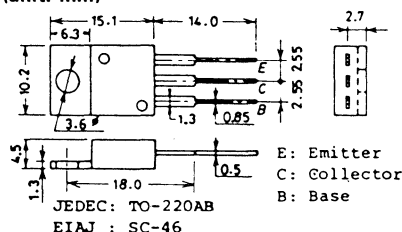
*The 2SA1291/2SC3255 are classified by 1A h_{FE} as follows:

70	Q	140	100	R	200	140	S	280
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Switching Time Test Circuit



Case Outline 2010A (unit: mm)



For details, refer to the description of the 2SC3255.

0183K1/TSIII No. 1201-1/3

2SA1317



2033

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3330

Low Frequency, General-Purpose Amp Applications

©1599

Use

- Capable of being used in the low frequency to high frequency range.

Features

- Large current capacity and wide ASO.

(): 2SA1317

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)60	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)6	V
Collector Current	I_C	(-)200	mA
Peak Collector Current	i_{cp}	(-)400	mA
Collector Dissipation	P_C	300	mW
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

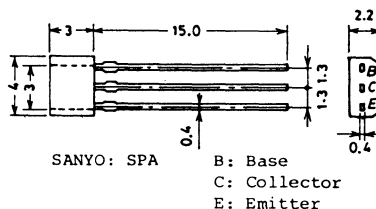
			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)40\text{V}, I_E=0$		(-)0.1		μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)5\text{V}, I_C=0$		(-)0.1		μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=(-)6\text{V}, I_C=(-)1\text{mA}$	100*		800*	
			(100)		(560)	
	$h_{FE}(2)$	$V_{CE}=(-)6\text{V}, I_C=(-)0.1\text{mA}$	70			
Gain Bandwidth Product	f_T	$V_{CE}=(-)6\text{V}, I_C=(-)10\text{mA}$		200		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)6\text{V}, f=1\text{MHz}$		3.0		pF
				(4.0)		

* The 2SA1317/2SC3330 are classified by 1mA h_{FE} as follows:

2SA1317	100	R	200	140	S	280	200	T	400	280	U	560			
2SC3330	100	R	200	140	S	280	200	T	400	280	U	560	400	V	800

Case Outline 2033

(unit:mm)



For details, refer to the description of the 2SC3330.

2SA1318



2003A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3331

Low Frequency, General-Purpose Amp Applications

©1600

Use

- . Capable of being used in the low frequency to high frequency range.

Features

- . Large current capacity and wide ASO.

(): 2SA1318

Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CB0}	(-)60	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)6	V
Collector Current	I_C	(-)200	mA
Peak Collector Current	i_{cp}	(-)400	mA
Collector Dissipation	P_C	500	mW
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

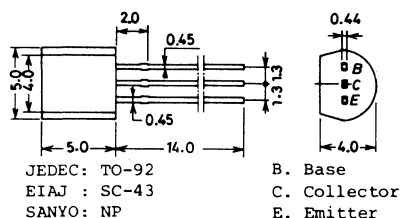
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40V, I_E=0$			(-)0.1	uA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5V, I_C=0$			(-)0.1	uA
DC Current Gain	$h_{FE(1)}^*$	$V_{CE}=(-)6V, I_C=(-)1mA$	100*		800*	
			(100)		(560)	
	$h_{FE(2)}$	$V_{CE}=(-)6V, I_C=(-)0.1mA$		70		
Gain Bandwidth Product	f_T	$V_{CE}=(-)6V, I_C=(-)10mA$		200		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)6V, f=1MHz$		3.0		pF
				(4.5)		

* The 2SA1318/2SC3331 are classified by 1mA h_{FE} as follows:

2SA1318	100	R	200	140	S	280	200	T	400	280	U	560	
2SC3331	100	R	200	140	S	280	200	T	400	280	U	560	400 V 800

Case Outline 2003A (unit:mm)



For details, refer to the description of the 2SC3331.

D054MY, TS No.1600-1/3

2SA1319



2003A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3332

High Voltage Switching Applications

©1334A

Features

- High breakdown voltage.
- Excellent h_{FE} linearity.
- Wide ASO and highly resistant to breakdown.
- Adoption of MBIT process.

(): 2SA1319

Absolute maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)180	V
Collector to Emitter Voltage	V_{CEO}	(-)160	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)0.7	A
Peak Collector Current	i_{cp}	(-)1.5	A
Collector Dissipation	P_C	700	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

Electrical Characteristics/ $T_a=25^\circ\text{C}$

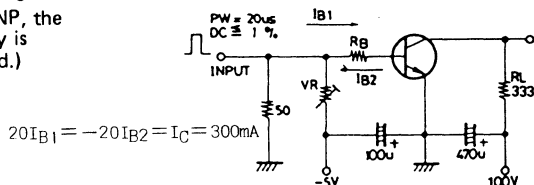
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)120\text{V}, I_E=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=(-)5\text{V}, I_C=(-)100\text{mA}$	100		400	
	$h_{FE}(2)$	$V_{CE}=(-)5\text{V}, I_C=(-)10\text{mA}$	80			
Gain Band-width Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		120		MHz
Common Base Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}$		(11)8		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)250\text{mA}, I_B=(-)25\text{mA}$		0.12	0.4	V
				(0.20)	(0.5)	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)250\text{mA}, I_B=(-)25\text{mA}$		(-)0.85	(-)1.2	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)180			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	(-)160			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$	(-)6			V
Turn-on Time	t_{on}	At specified test circuit	(60)50			ns
Storage Time	t_{stg}	"	(900)1000			ns
Fall Time	t_f	"	(60)60			ns

*: The 2SA1319/2SC3332 are classified by 100mA h_{FE} as follows:

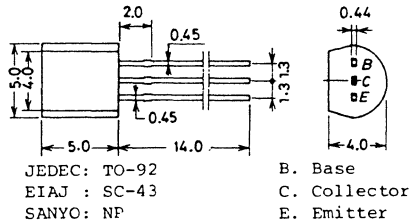
100	R	200	140	S	280	200	T	400
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Switching Time Test Circuit

(For PNP, the polarity is reversed.)



Case Outline 2003A (unit: mm)



For details, refer to the description of the 2SC3332.



High Speed Switching Applications

©1341

Features

- . High switching speed.
- . High breakdown voltage.
- . Very small-sized package permitting 2SA1331-used sets to be made smaller and slimmer.

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	-60	V
Collector to Emitter Voltage	V_{CE0}	-50	V
Emitter to Base Voltage	V_{EB0}	-5	V
Collector Current	I_C	-150	mA
Peak Collector Current	i_{cp}	-400	mA
Collector Dissipation	P_C	150	mW
Junction Temperature	T_j	125	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +125	$^{\circ}\text{C}$

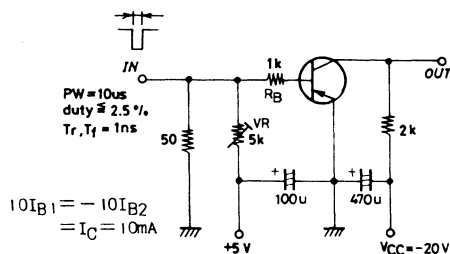
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=-40\text{V}, I_E=0$			-0.1	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=-4\text{V}, I_C=0$			-0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=-6\text{V}, I_C=-1\text{mA}$	90*		400*	
Gain Bandwidth Product	f_T	$V_{CE}=-6\text{V}, I_C=-1\text{mA}$		100		MHz
Output Capacitance	C_{ob}	$V_{CB}=-6\text{V}, f=1\text{MHz}$		3.5		pF
C-E Saturation Voltage	$V_{CE}(\text{sat})$	$I_C=-10\text{mA}, I_B=-1\text{mA}$		-0.1	-0.4	V
B-E Saturation Voltage	$V_{BE}(\text{sat})$	$I_C=-10\text{mA}, I_B=-1\text{mA}$		-0.75	-1.1	V
C-B Breakdown Voltage	$V(\text{BR})_{CBO}$	$I_C=-10\mu\text{A}, I_E=0$	-60			V
C-E Breakdown Voltage	$V(\text{BR})_{CEO}$	$I_C=-1\text{mA}, R_{BE}=\infty$	-50			V
E-B Breakdown Voltage	$V(\text{BR})_{EBO}$	$I_E=-10\mu\text{A}, I_C=0$	-5			V
Delay Time	t_d	At specified test circuit		40		ns
Rise Time	t_r	At specified test circuit		120		ns
Storage Time	t_{stg}	At specified test circuit		190		ns
Fall Time	t_f	At specified test circuit		200		ns

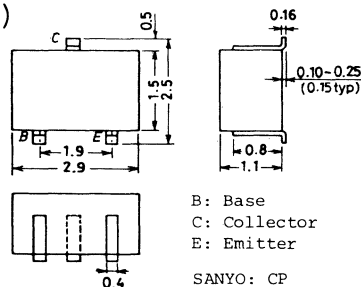
* The 2SA1331 is classified by $1A h_{FE}$ as follows :

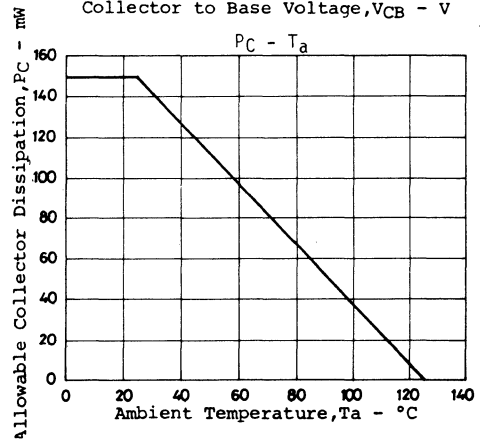
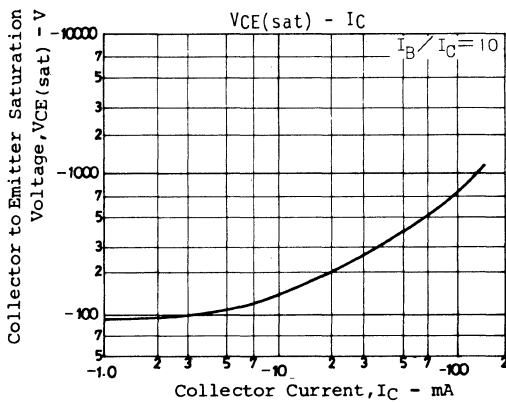
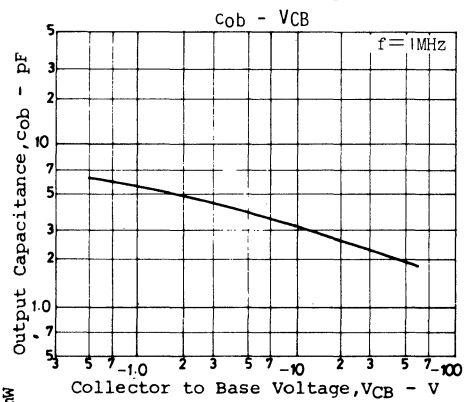
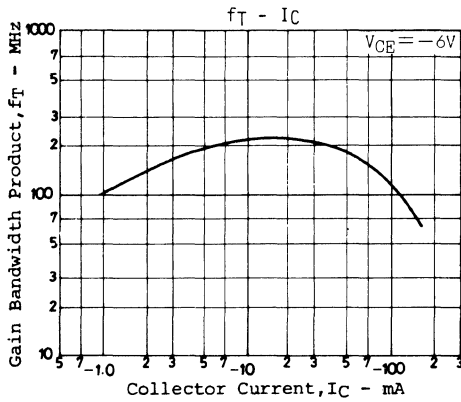
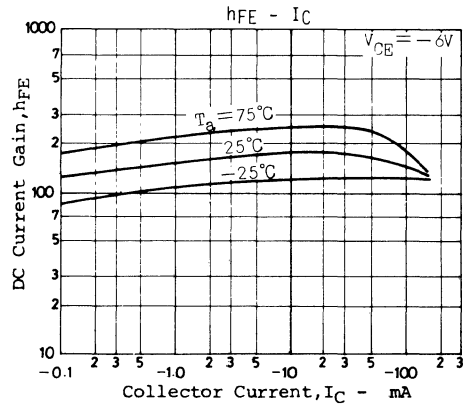
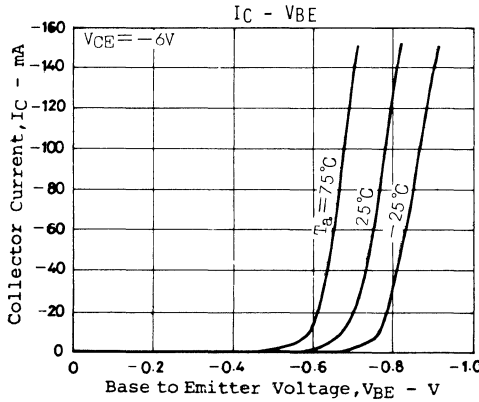
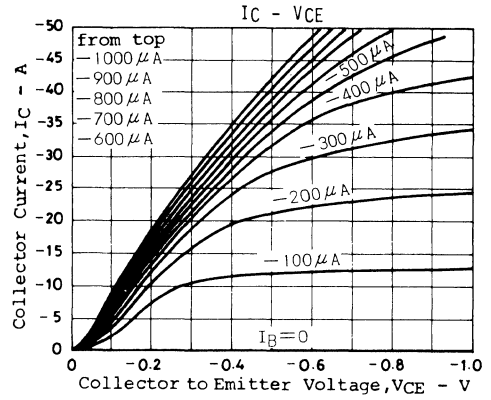
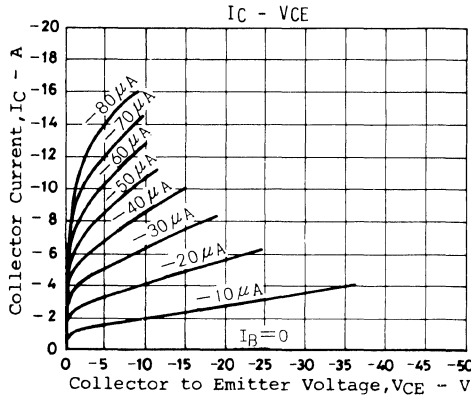
90	4	180	135	5	270	200	6	400
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Switching Time Test Circuit



Case Outline 2018 (unit:mm)





2SA1338

2018

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3392

High Speed Switching Applications

©1421

Features

- Adoption of FBET process
- High breakdown voltage: $V_{CE0}=(-)50V$
- Large current capacity and high f_T
- Very small-sized package permitting sets to be small-sized, slim
(): 2SA1338

Absolute Maximum Ratings at $T_a=25^{\circ}C$

			unit
Collector to Base Voltage	V_{CBO}	$(-)60$	V
Collector to Emitter Voltage	V_{CEO}	$(-)50$	V
Emitter to Base Voltage	V_{EBO}	$(-)5$	V
Collector Current	I_C	$(-)500$	mA
Peak Collector Current	i_{cp}	$(-)800$	mA
Collector Dissipation	P_C	200	mW
Junction Temperature	T_j	150	$^{\circ}C$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}C$

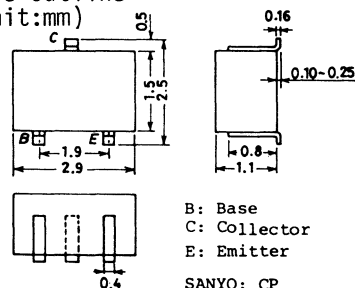
Electrical Characteristics at $T_a=25^{\circ}C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40V, I_E=0$			$(-)0.1$	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$			$(-)0.1$	μA
DC Current gain	h_{FE}	$V_{CE}=(-)5V, I_C=(-)10mA$	100*		560*	
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		300 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10V, f=1MHz$		3.7 (5.6)		pF
C-E Saturation Voltage	$V_{CE}(sat)$	$I_C=(-)100mA, I_B=(-)10mA$		0.1 (0.15)	0.3 (0.4)	V
B-E Saturation Voltage	$V_{BE}(sat)$	$I_C=(-)100mA, I_B=(-)10mA$		0.8	1.2	V
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)60$			V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	$(-)50$			V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E=(-)10\mu A, I_C=0$	$(-)5$			V
Turn-on Time	t_{on}	$V_{CC}=20V,$		70 (70)		ns
Storage Time	t_{stg}	$I_C=10I_{B1}=-10I_{B2}=100mA$	400 (400)			ns
Fall Time	t_f			70 (50)		ns

* : The 2SA1338/2SC3392 are classified by 10mA h_{FE} as follows:

2SA1338	100	AL4	200	140	AL5	280
	200	AL6	400	280	AL7	560
2SC3392	100	AY4	200	140	AY5	280
	200	AY6	400	280	AY7	560

Case Outline 2018 (unit:mm)



For details, refer to the description of the 2SC3392.

2SA1339



2033

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3393

High Speed Switching Applications

©1392

Features

- Very small-sized package permitting sets to be small-sized, slim
 - High breakdown voltage: $V_{CEO}=(-)50V$
 - Complementary pair transistor having large current capacity and high f_T
 - Adoption of FBET process
- () : 2SA1339

Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	(-) 60	V
Collector to Emitter Voltage	V_{CEO}	(-) 50	V
Emitter to Base Voltage	V_{EBO}	(-) 5	V
Collector Current	I_C	(-) 500	mA
Peak Collector Current	i_{cp}	(-) 800	mA
Collector Dissipation	P_C	300	mW
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

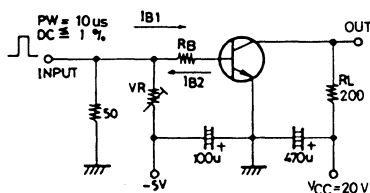
Electrical Characteristics at $T_a=25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40V, I_E=0$			(-) 0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V$			(-) 0.1	μA
DC Current gain	h_{FE}	$V_{CE}=(-)5V, I_C=(-)10mA$	100*		560*	
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		300		MHz
				(200)		
Output Capacitance	c_{ob}	$V_{CB}=(-)10V, f=1MHz$		3.7		pF
				(5.6)		
C-E Saturation Voltage	$V_{CE}(sat)$	$I_C=(-)100mA, I_B=(-)10mA$		0.1	0.3	V
				(0.15)	(0.4)	
B-E Saturation Voltage	$V_{BE}(sat)$	$I_C=(-)100mA, I_B=(-)10mA$		0.8	1.2	V
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C=(-)10\mu A, I_E=0$		(-) 60		V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$		(-) 50		V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E=(-)10\mu A, I_C=\infty$		(-) 5		V
Rise Time	t_{on}	$V_{CC}=20V$		70 (70)		ns
Storage Time	t_{stg}	$I_C=10I_{B1}=-10I_{B2}=100mA$		400 (400)		ns
Fall Time	t_f			70 (50)		ns

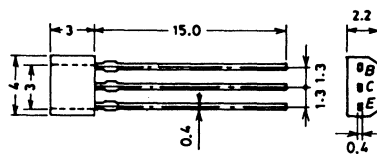
* : The 2SA1339/2SC3393 are classified by 10mA h_{FE} as follows:

100	R	200	140	S	280
200	T	400	280	U	560

Switching Time Test Circuit



Case Outline 2033 (unit:mm)



B: Base
C: Collector
E: Emitter
SANYO: SPA

For details, refer to the description of the 2SC3393

2SA1341

2018

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3395

Switching Applications (with Bias Resistance)

©1283B

Applications

Switching circuit, inverter, interface circuit, driver

Features

- Built-in bias resistor ($R_1=47k\Omega$, $R_2=47k\Omega$).
- Small-sized package (CP).

(): 2SA1341

Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-) 50	V
Collector to Emitter Voltage	V_{CEO}	(-) 50	V
Emitter to Base Voltage	V_{EBO}	(-) 10	V
Collector Current	I_C	(-) 100	mA
Peak Collector Current	i_{cp}	(-) 200	mA
Collector Dissipation	P_C	200	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to $+150$	$^\circ\text{C}$

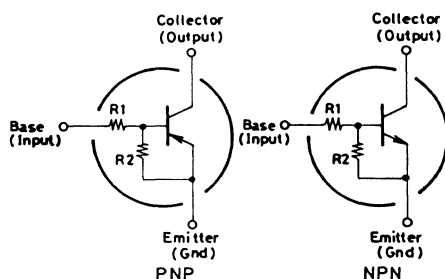
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}$, $I_E=0$			(-)0.1	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}$, $I_B=0$			(-)0.5	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}$, $I_C=0$	(-)30	(-)53	(-)80	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}$, $I_C=(-)5\text{mA}$	50			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}$, $I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}$, $f=1\text{MHz}$		3.5 (5.3)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{mA}$, $I_B=(-)0.25\text{mA}$		(-)0.1	(-)0.3	V

Marking on Device

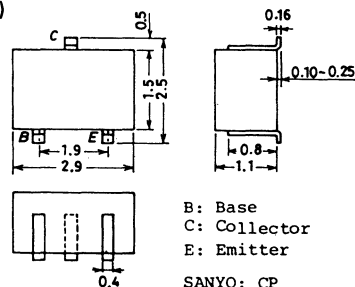
2SA1341:BL, 2SC3395:BY

Electrical Connection



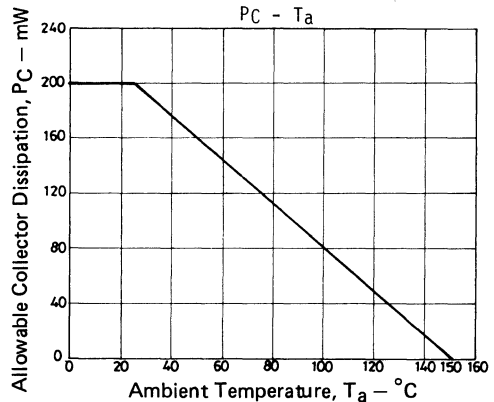
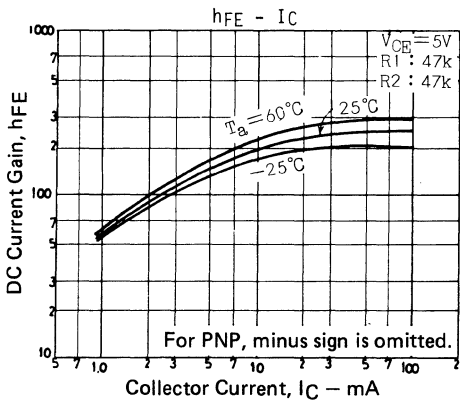
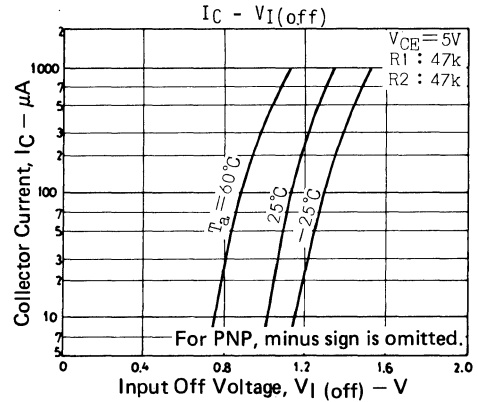
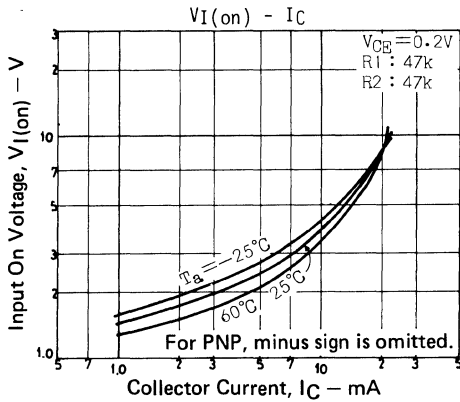
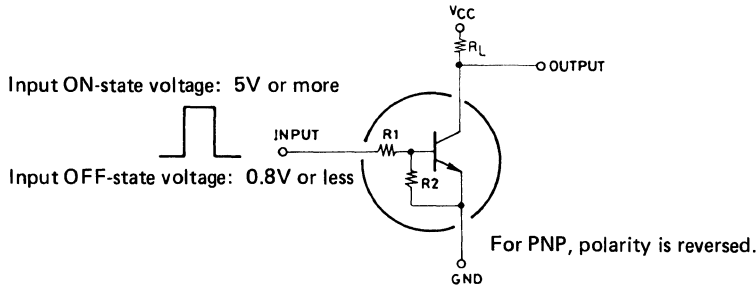
Case Outline 2018

(unit: mm)



			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)50$			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	$(-)50$			V
Input Off Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	$(-)0.8$	$(-)1.1$	$(-)1.5$	V
Input On Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)5mA$	$(-)1.0$	$(-)2.5$	$(-)5.0$	V
Input Resistance	R_1		32	47	62	k Ω
Input Resistance Ratio	R_1/R_2		0.9	1.0	1.1	—

■ Sample Application Circuit



2SA1342

2018

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3396

Switching Applications (with Bias Resistance)

©1284B

Applications

Switching circuit, inverter, interface circuit, driver

Features

- Built-in bias resistor ($R_1=22k\Omega$, $R_2=22k\Omega$).
- Small-sized package (CP).

(): 2SA1342

Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)50	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)10	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	200	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

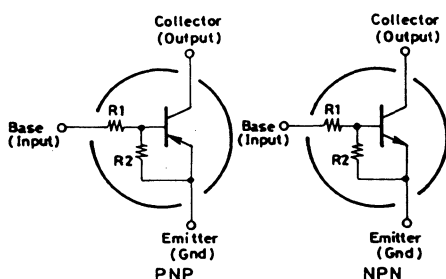
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}$, $I_E=0$			(-)0.1	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}$, $I_B=0$			(-)0.5	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}$, $I_C=0$	(-)70	(-)113	(-)150	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}$, $I_C=(-)5\text{mA}$	50			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}$, $I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}$, $f=1\text{MHz}$		3.5 (5.3)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)10\text{mA}$, $I_B=(-)0.5\text{mA}$	(-)0.1	(-)0.3		V

Marking on Device

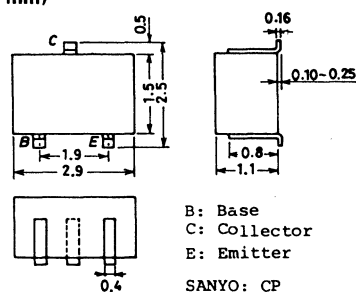
2SA1342: CL, 2SC3396: CY

Electrical Connection



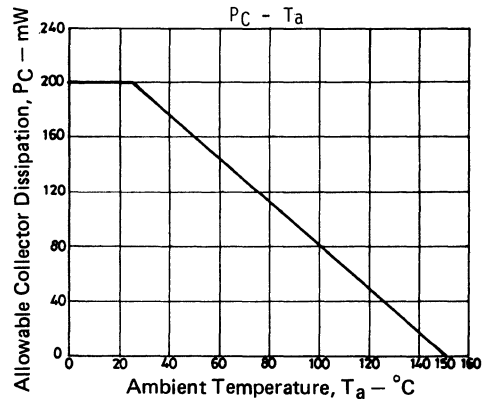
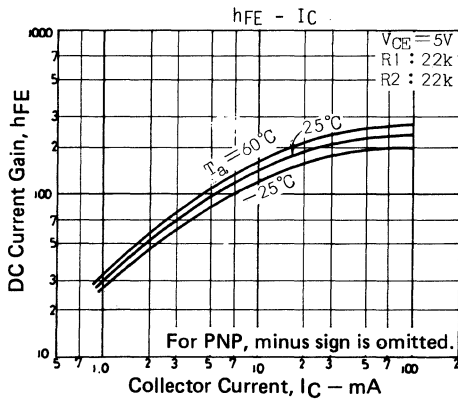
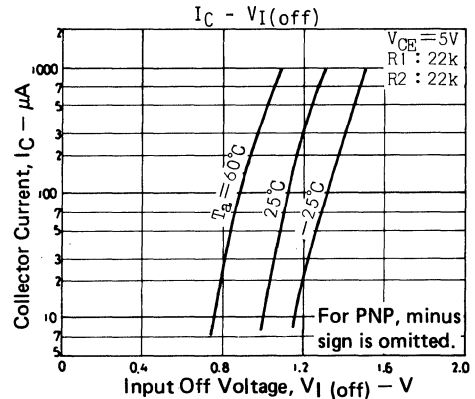
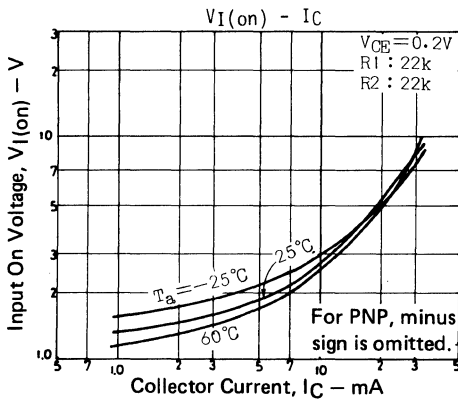
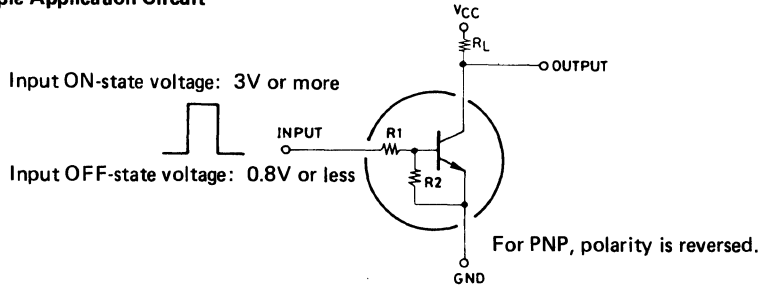
Case Outline 2018

(unit: mm)



			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-)10\mu A, I_E = 0$	$(-)50$			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-)100\mu A, R_{BE} = \infty$	$(-)50$			V
Input Off Voltage	$V_{I(off)}$	$V_{CE} = (-)5V, I_C = (-)100\mu A$	$(-)0.8$	$(-)1.1$	$(-)1.5$	V
Input On Voltage	$V_{I(on)}$	$V_{CE} = (-)0.2V, I_C = (-)5mA$	$(-)1.0$	$(-)1.9$	$(-)3.0$	V
Input Resistance	R_1		15	22	29	k Ω
Input Resistance Ratio	R_1/R_2		0.9	1.0	1.1	—

■ Sample Application Circuit



2SA1343

PNP/NPN Epitaxial Planar Silicon Transistors

Switching Applications (with Bias Resistance)

Applications

Features

- Built-in bias resistor ($R_1=46k\Omega$, $R_2=23k\Omega$).
- Small-sized package (CP).

(): 2SA1343

Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$

Absolute Maximum Ratings/T _a =25°C			unit
Collector to Base Voltage	V _{CB0}	(-)50	V
Collector to Emitter Voltage	V _{CEO}	(-)50	V
Emitter to Base Voltage	V _{EB0}	(-)10	V
Collector Current	I _C	(-)100	mA
Peak Collector Current	i _{cp}	(-)200	mA
Collector Dissipation	P _C	200	mW
Junction Temperature	T _j	150	°C
Storage Temperature	T _{stg}	-55 to +150	°C

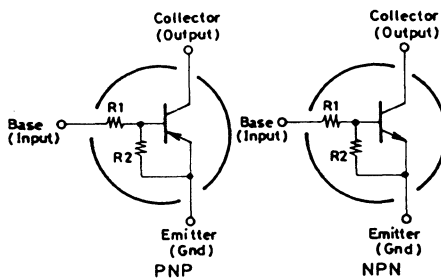
Electrical Characteristics/ $T_a=25^{\circ}\text{C}$

Electrical Characteristics/T _a =25°C			min	typ	max	unit
Collector Cutoff Current	I _{CBO}	V _{CB} =(-)40V, I _E =0			(-)0.1	μA
Collector Cutoff Current	I _{CEO}	V _{CE} =(-)40V, I _B =0			(-)0.5	μA
Emitter Cutoff Current	I _{EBO}	V _{EB} =(-)5V, I _C =0	(-)40	(-)72	(-)100	μA
DC Current Gain	h _{FE}	V _{CE} =(-)5V, I _C =(-)5mA	50			
Gain Band-width product	f _T	V _{CE} =(-)10V, I _C =(-)5mA		250 (200)		MHz
Output Capacitance	c _{ob}	V _{CB} =(-)10V, f=1MHz		3.5 (5.3)		pF
Collector to Emitter Saturation Voltage	V _{CE(sat)}	I _C =(-)5mA, I _B =(-)0.25mA		(-)0.1	(-)0.3	V

Marking on Device

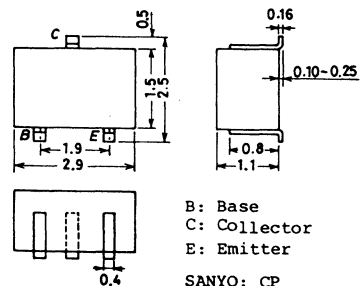
2SA1343: DL, 2SC3397: DY

Electrical Connection



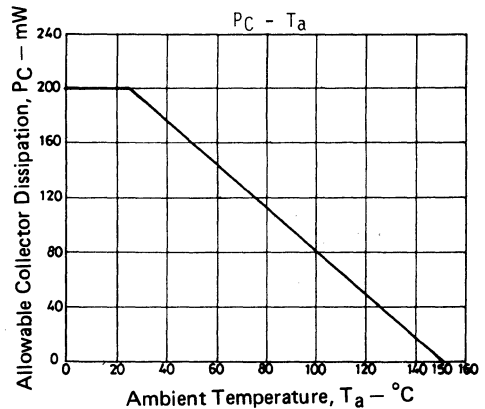
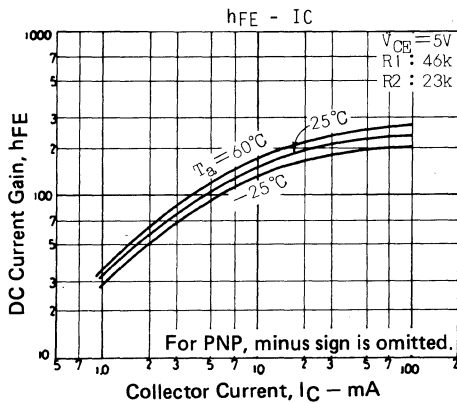
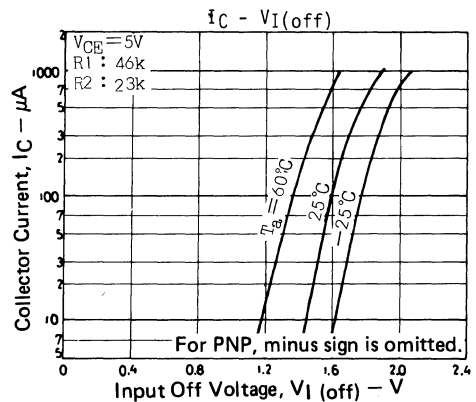
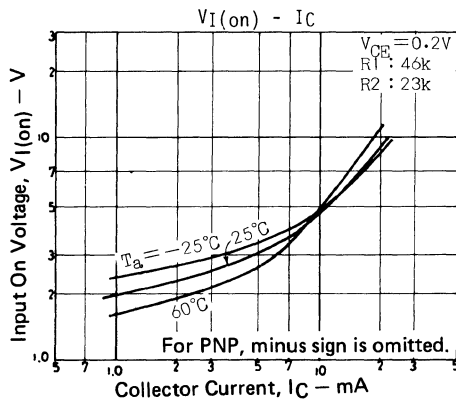
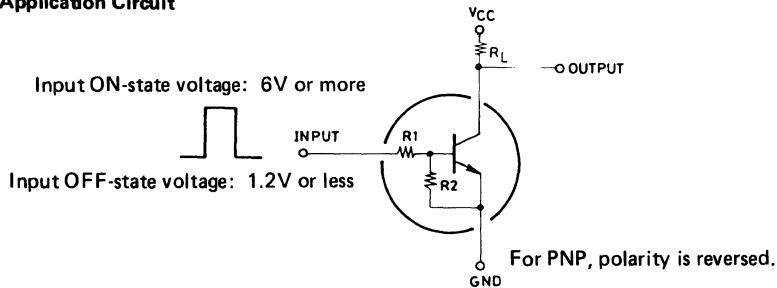
Case Outline 2018

(unit: mm)



			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-)10\mu A, I_E = 0$	$(-)50$			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-)100\mu A, R_{BE} = \infty$	$(-)50$			V
Input Off Voltage	$V_{I(off)}$	$V_{CE} = (-)5V, I_C = (-)100\mu A$	$(-)1.2$	$(-)1.6$	$(-)2.3$	V
Input On Voltage	$V_{I(on)}$	$V_{CE} = (-)0.2V, I_C = (-)5mA$	$(-)1.5$	$(-)3.1$	$(-)6.0$	V
Input Resistance	R_1		32	46	60	k Ω
Input Resistance Ratio	R_1/R_2		1.8	2.0	2.2	—

Sample Application Circuit



2SA1344

2018

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3398

Switching Applications (with Bias Resistance)

©1286B

Applications

Switching circuit, inverter, interface circuit, driver

Features

- Built-in bias resistor ($R_1=10k\Omega$, $R_2=10k\Omega$).
- Small-sized package (CP).

(): 2SA1344

Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)50	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)10	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	200	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

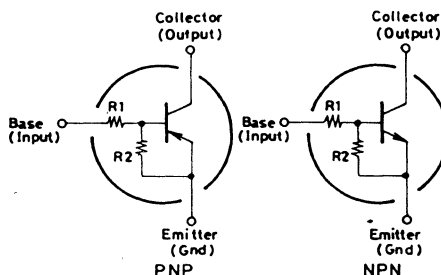
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}$, $I_E=0$			(-)0.1	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}$, $I_B=0$			(-)0.5	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}$, $I_C=0$	(-)170	(-)250	(-)330	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}$, $I_C=(-)10\text{mA}$	50			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}$, $I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}$, $f=1\text{MHz}$		3.5 (5.3)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)10\text{mA}$, $I_B=(-)0.5\text{mA}$	(-)0.1	(-)0.3		V

Marking on Device

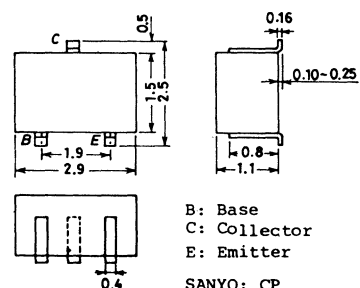
2SA1344: EL, 2SC3398: EY

Electrical Connection



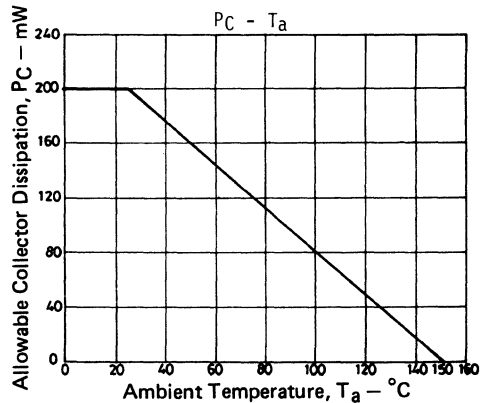
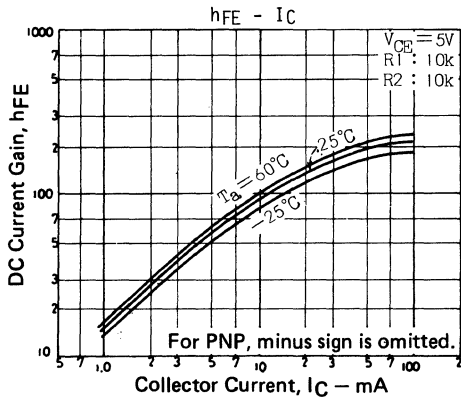
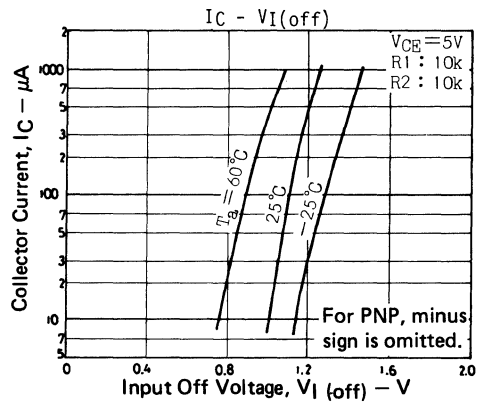
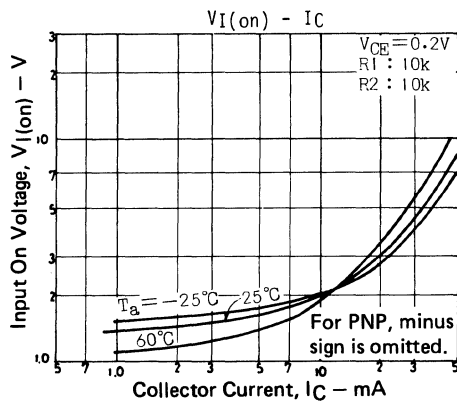
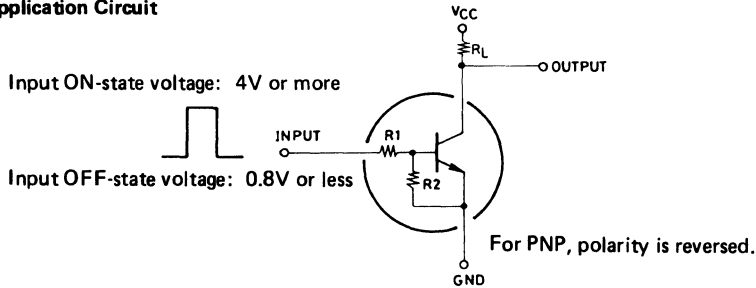
Case Outline 2018

(unit: mm)



			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)50$			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	$(-)50$			V
Input Off Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	$(-)0.8$	$(-)1.1$	$(-)1.5$	V
Input On Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)10mA$	$(-)1.0$	$(-)2.0$	$(-)4.0$	V
Input Resistance	R_1		7.0	10	13	k Ω
Input Resistance Ratio	R_1/R_2		0.9	1.0	1.1	—

■ Sample Application Circuit



2SA1345



2033

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3399

Switching Applications (with Bias Resistance)

©1287B

Applications

Switching circuit, inverter, interface circuit, driver

Features

- Built-in bias resistor ($R_1=47k\Omega$, $R_2=47k\Omega$).
- Small-sized package (SPA).

(): 2SA1345

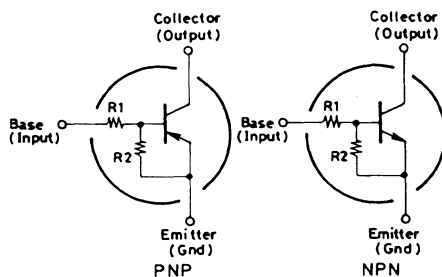
Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-) 50	V
Collector to Emitter Voltage	V_{CEO}	(-) 50	V
Emitter to Base Voltage	V_{EBO}	(-) 10	V
Collector Current	I_C	(-) 100	mA
Peak Collector Current	i_{cp}	(-) 200	mA
Collector Dissipation	P_C	300	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to $+150$	$^\circ\text{C}$

Electrical Characteristics/ $T_a=25^\circ\text{C}$

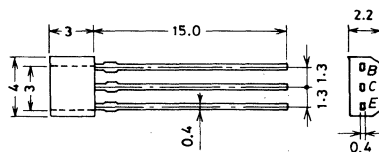
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}$, $I_E=0$			(-) 0.1	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}$, $I_B=0$			(-) 0.5	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}$, $I_C=0$	(-) 30	(-) 53	(-) 80	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}$, $I_C=(-)5\text{mA}$	50			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}$, $I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}$, $f=1\text{MHz}$		3.7 (5.5)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{mA}$, $I_B=(-)0.25\text{mA}$		(-) 0.1	(-) 0.3	V

Electrical Connection



Case Outline 2033

(unit: mm)



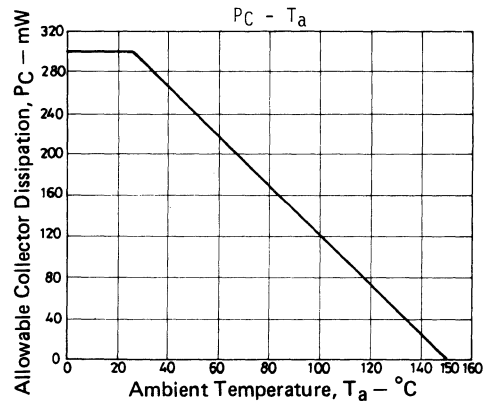
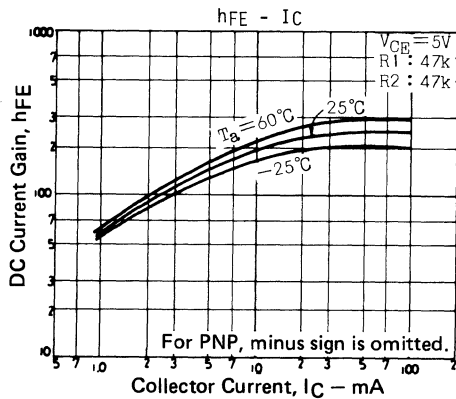
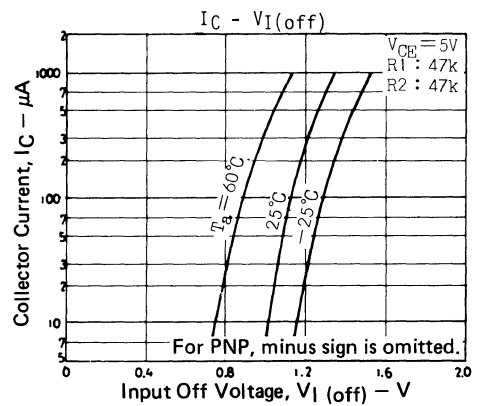
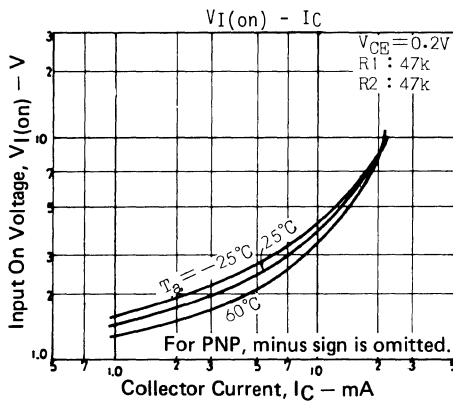
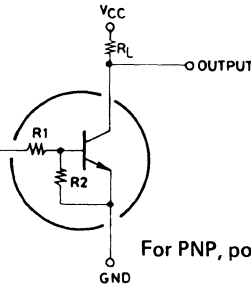
B: Base
C: Collector
E: Emitter
SANYO: SPA

			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)\infty$			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	$(-)\infty$			V
Input Off Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	$(-)\infty$	$(-)\infty$	$(-)\infty$	V
Input On Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)5mA$	$(-)\infty$	$(-)\infty$	$(-)\infty$	V
Input Resistance	R_1		32	47	62	k Ω
Input Resistance Ratio	R_1/R_2		0.9	1.0	1.1	—

■ Sample Application Circuit

Input ON-state voltage: 5V or more

Input OFF-state voltage: 0.8V or less



2SA1346



2033

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3400

Switching Applications (with Bias Resistance)

©1288B

Applications

Switching circuit, inverter, interface circuit, driver

Features

- Built-in bias resistor ($R_1=22k\Omega$, $R_2=22k\Omega$).
- Small-sized package (SPA).

(): 2SA1346

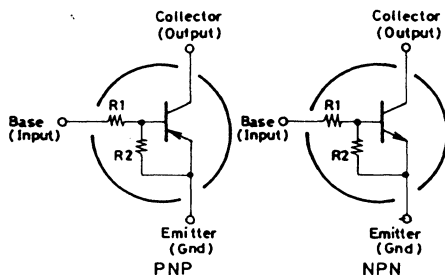
Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-) 50	V
Collector to Emitter Voltage	V_{CE0}	(-) 50	V
Emitter to Base Voltage	V_{EB0}	(-) 10	V
Collector Current	I_C	(-) 100	mA
Peak Collector Current	i_{cp}	(-) 200	mA
Collector Dissipation	P_C	300	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to $+150$	$^\circ\text{C}$

Electrical Characteristics/ $T_a=25^\circ\text{C}$

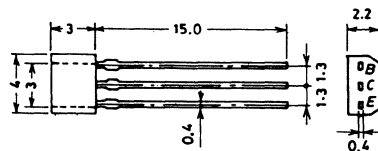
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}$, $I_E=0$			(-) 0.1	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}$, $I_B=0$			(-) 0.5	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}$, $I_C=0$	(-) 70	(-) 113	(-) 150	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}$, $I_C=(-)5\text{mA}$	50			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}$, $I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}$, $f=1\text{MHz}$		3.7 (5.5)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)10\text{mA}$, $I_B=(-)0.5\text{mA}$		(-) 0.1	(-) 0.3	V

Electrical Connection



Case Outline 2033

(unit: mm)

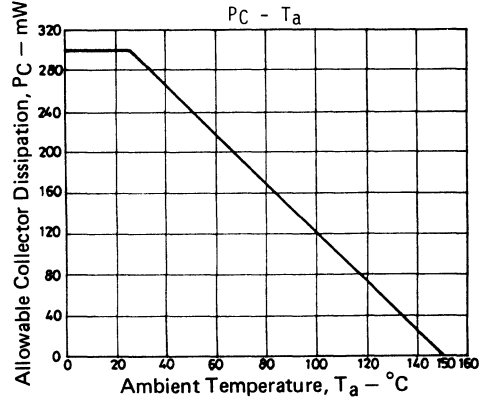
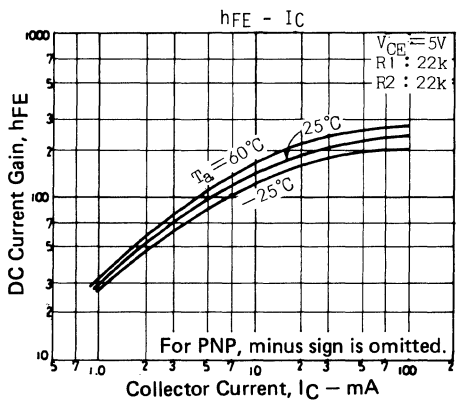
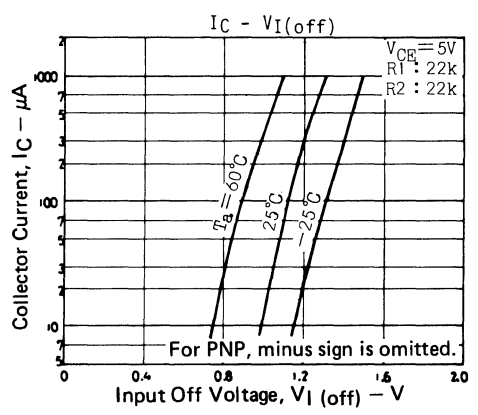
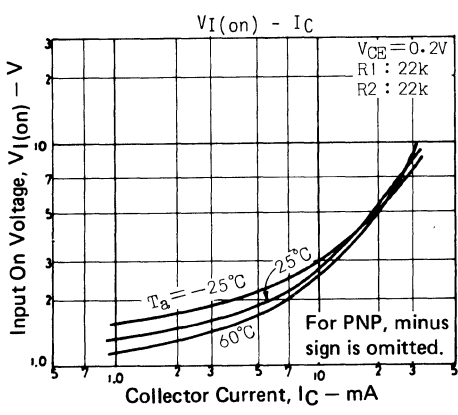
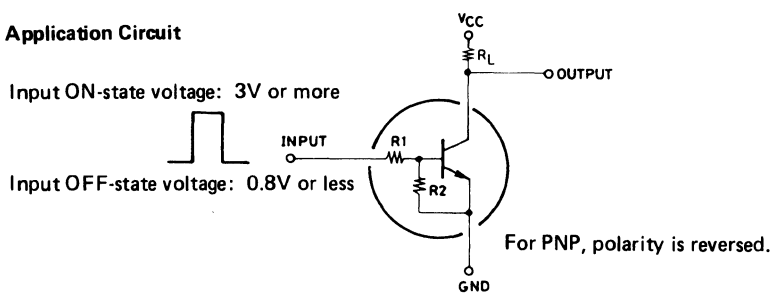


B: Base
C: Collector
E: Emitter

SANYO: SPA

			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	(-)50			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	(-)50			V
Input Off Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	(-)0.8	(-)1.1	(-)1.5	V
Input On Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)5mA$	(-)1.0	(-)1.9	(-)3.0	V
Input Resistance	R_1		15	22	29	k Ω
Input Resistance Ratio	R_1/R_2		0.9	1.0	1.1	—

■ Sample Application Circuit



2SA1347



2033

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3401

Switching Applications (with Bias Resistance)

©1289B

Applications

Switching circuit, inverter, interface circuit, driver

Features

- Built-in bias resistor ($R_1=46k\Omega$, $R_2=23k\Omega$).
- Small-sized package (SPA).

(): 2SA1347

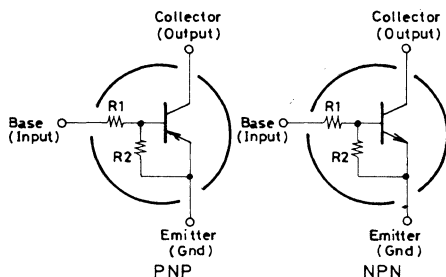
Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)50	V
Collector to Emitter Voltage	V_{CEO}	(-)50	V
Emitter to Base Voltage	V_{EBO}	(-)10	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	300	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

Electrical Characteristics/ $T_a=25^\circ\text{C}$

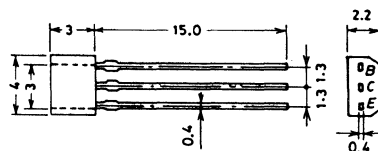
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}$, $I_E=0$			(-)0.1	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}$, $I_B=0$			(-)0.5	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}$, $I_C=0$	(-)40	(-)72	(-)100	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}$, $I_C=(-)5\text{mA}$	50			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}$, $I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}$, $f=1\text{MHz}$		3.7 (5.5)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{mA}$, $I_B=(-)0.25\text{mA}$	(-)0.1	(-)0.3		V

Electrical Connection



Case Outline 2033

(unit: mm)



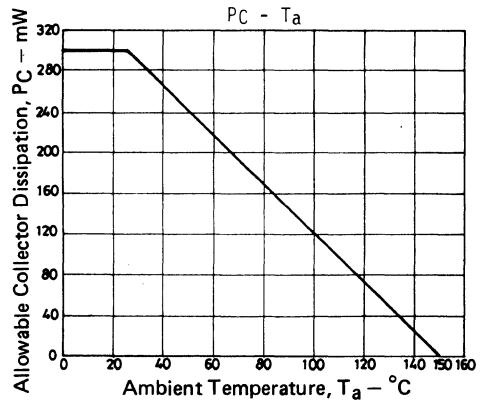
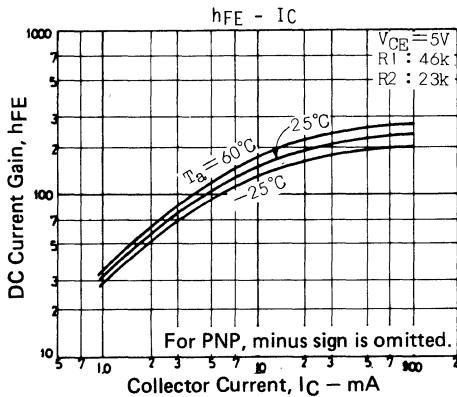
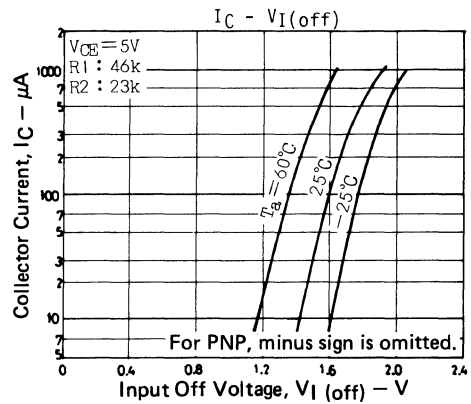
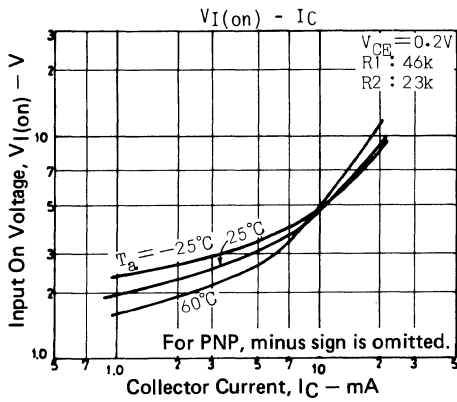
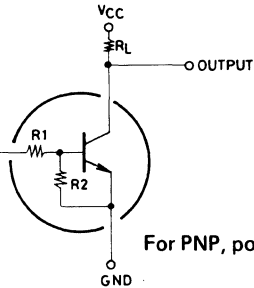
B: Base
C: Collector
E: Emitter
SANYO: SPA

			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)-50$			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	$(-)-50$			V
Input Off Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	$(-)-1.2$	$(-)-1.6$	$(-)-2.3$	V
Input On Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)5mA$	$(-)-1.5$	$(-)-3.1$	$(-)-6.0$	V
Input Resistance	R_1		32	46	60	k Ω
Input Resistance Ratio	R_1/R_2		1.8	2.0	2.2	—

■ Sample Application Circuit

Input ON-state voltage: 6V or more

Input OFF-state voltage: 1.2V or less



2SA1348



2033

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3402

Switching Applications (with Bias Resistance)

©1290B

Applications

Switching circuit, inverter, interface circuit, driver

Features

- Built-in bias resistor ($R_1=10k\Omega$, $R_2=10k\Omega$).
- Small-sized package (SPA).

(): 2SA1348

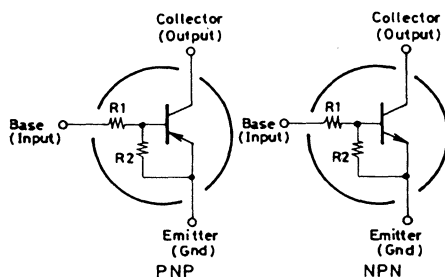
Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-) 50	V
Collector to Emitter Voltage	V_{CE0}	(-) 50	V
Emitter to Base Voltage	V_{EB0}	(-) 10	V
Collector Current	I_C	(-) 100	mA
Peak Collector Current	i_{cp}	(-) 200	mA
Collector Dissipation	P_C	300	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to 150	$^\circ\text{C}$

Electrical Characteristics/ $T_a=25^\circ\text{C}$

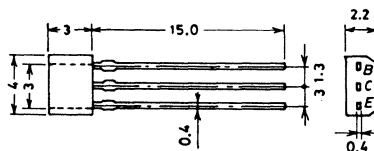
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}$, $I_E=0$			(-) 0.1	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}$, $I_B=0$			(-) 0.5	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}$, $I_C=0$	(-) 170	(-) 250	(-) 330	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}$, $I_C=(-)10\text{mA}$	50			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}$, $I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}$, $f=1\text{MHz}$		3.7 (5.5)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)10\text{mA}$, $I_B=(-)0.5\text{mA}$		(-) 0.1	(-) 0.3	V

Electrical Connection



Case Outline 2033

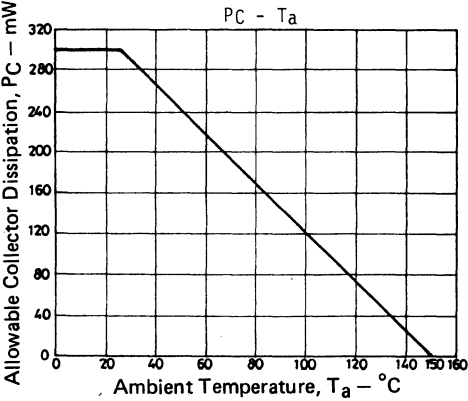
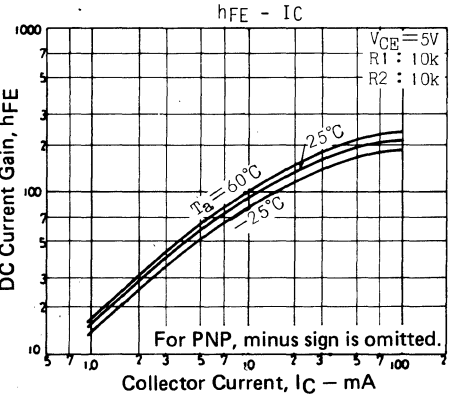
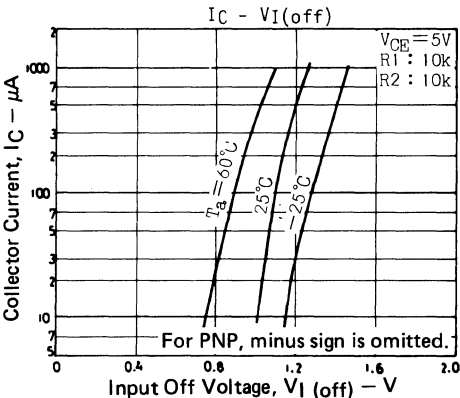
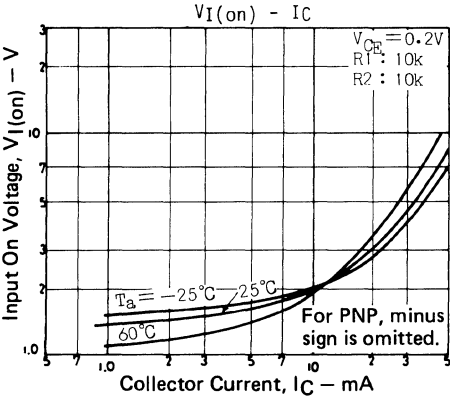
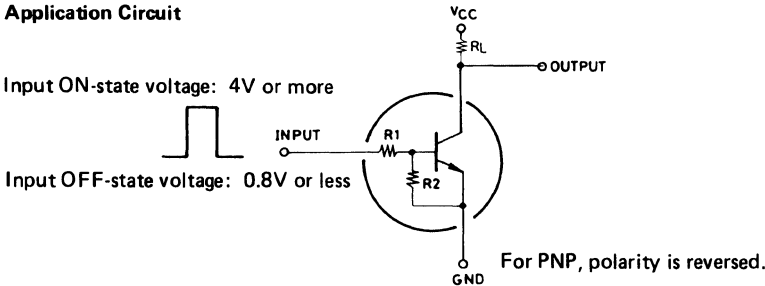
(unit: mm)



B: Base
C: Collector
E: Emitter
SANYO: SPA

			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)\text{50}$			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	$(-)\text{50}$			V
Input Off Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	$(-)\text{0.8}$	$(-)\text{1.1}$	$(-)\text{1.5}$	V
Input On Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)10mA$	$(-)\text{1.0}$	$(-)\text{2.0}$	$(-)\text{4.0}$	V
Input Resistance	R_1		7.0	10	13	k Ω
Input Resistance Ratio	R_1/R_2		0.9	1.0	1.1	—

■ Sample Application Circuit



2009

High-Definition CRT Display Video Output Applications

Use

- Color TV Chroma output and high breakdown voltage driver

Features.

- High breakdown voltage: $V_{CE0} \geq 200V$
 - Small reverse transfer capacitance and excellent high frequency characteristic
 $c_{re} = 1.2pF$ (NPN), $1.7pF$ (PNP)
 - Adoption of FBET process
- () : 2SA1352

Absolute Maximum Ratings at Ta=25°C

Absolute Maximum Ratings at Ta=25°C				unit
Collector to Base Voltage	V _{CB0}	(-) 200		V
Collector to Emitter Voltage	V _{CEO}	(-) 200		V
Emitter to Base Voltage	V _{EB0}	(-) 5		V
Collector Current	I _C	(-) 100		mA
Peak Collector Current	i _{cp}	(-) 200		mA
Collector Dissipation	P _C	1.2		W
		T _C =25°C	5	W
Junction Temperature	T _j	150		°C
Storage Temperature	T _{stg}	-55 to +150		°C

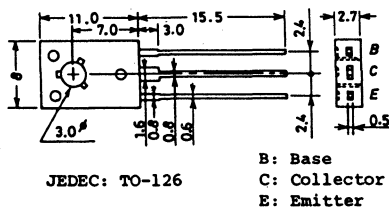
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

Electrical Characteristics at Ta=25°C			min	typ	max	unit
Collector Cutoff Current	ICBO	VCB=(-) 150V, IE=0			(-) 0.1	uA
Emitter Cutoff Current	IEBO	VEB=(-) 4V, IC=0			(-) 0.1	uA
DC Current Gain	hFE	VCE=(-) 40V, IC=(-) 10mA	40*		320*	
Gain Bandwidth Product	fT	VCE=(-) 30V, IC=(-) 10mA		70		MHz
C-E Saturation Voltage	VCE(sat)	IC=(-) 20mA, IB=(-) 2mA			(-) 0.6	V
B-E Saturation Voltage	VBE(sat)	IC=(-) 20mA, IB=(-) 2mA			(-) 1.0	V
C-B Breakdown Voltage	V(BR)CBO	IC=(-) 10uA, IE=0	(-) 200			V
C-E Breakdown Voltage	V(BR)CEO	IC=(-) 1mA, RE=∞	(-) 200			V
E-B Breakdown Voltage	V(BR)EBO	IE=(-) 10uA, IC=∞	(-) 5			V
Output Capacitance	cob	VCB=(-) 30V, f=1MHz		1.7 (2.6)		pF
Reverse Transfer Capacitance	cre	VCB=(-) 30V, f=1MHz		1.2 (1.7)		pF

* : The 2SA1352/2SC3416 are classified by 10mA hFE as follows:

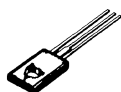
40	C	80	60	D	120	100	E	200	160	F	320
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Case Outline 2009
(unit:mm)



For details, refer to the description of the 2SC3416.

2SA1353



2009

PNP/NPN Epitaxial Planar
Silicon Transistors**2SC3417**

High-Definition CRT Display Video Output Applications

E1390B

Use

- High-definition CRT display
- Color TV chroma output and high breakdown voltage driver

Features

- High breakdown voltage: $V_{CE0} \geq 300V$
- Excellent high frequency characteristic: $c_{re} = 1.8pF$ (typ)
- Adoption of MBIT process

(): 2SA1353

Absolute Maximum Ratings at $T_a = 25^\circ C$

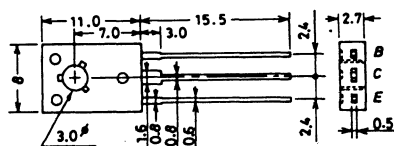
Absolute Maximum Ratings at Ta=25°C			unit
Collector to Base Voltage	VCBO	(-) 300	V
Collector to Emitter Voltage	VCEO	(-) 300	V
Emitter to Base Voltage	VEBO	(-) 5	V
Collector Current	IC	(-) 100	mA
Peak Collector Current	icp	(-) 200	mA
Collector Dissipation	PC	1.2	W
	Tc=25°C	7	W
Junction Temperature	Tj	150	°C
Storage Temperature	Tsta	-55 to +150	°C

Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-) 200V, I_E = 0$			(-) 0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-) 4V, I_C = 0$			(-) 0.1	μA
DC Current Gain	h_{FE}^*	$V_{CE} = (-) 10V, I_C = (-) 10mA$	40		320	
Gain Bandwidth Product	f_T	$V_{CE} = (-) 30V, I_C = (-) 10mA$		70		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-) 20mA, I_B = (-) 2mA$			(-) 0.6	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = (-) 20mA, I_B = (-) 2mA$			(-) 1.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-) 10\mu A, I_E = 0$	(-) 300			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_E = (-) 1mA, R_{BE} = \infty$	(-) 300			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-) 10\mu A, I_C = 0$	(-) 5			V
Output Capacitance	c_{ob}	$V_{CB} = (-) 30V, f = 1MHz$		2.6 (3.1)		pF
Reverse Transfer Capacitance	c_{re}	$V_{CB} = (-) 30V, f = 1MHz$		1.8 (2.3)		pF

* : The 2SA1353/2SC3417 are classified by 10mA h_{FE} as follows:

40	C	80	60	D	120	100	E	200	160	F	320
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Case Outline 2009
(unit:mm)

JEDEC: TO-126

B: Base
C: Collector
E: Emitter

For details, refer to the description of the 2SC3417.

2SA1370



2006A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3467

High-Definition CRT Display Video Output Applications

©1412A

Use

- Color TV chroma output and high breakdown voltage driver

Features

- High breakdown voltage: $V_{CE0} \geq 200V$
- Small reverse transfer capacitance and excellent high frequency characteristic $c_{re} = 1.2pF$ (NPN), $1.7pF$ (PNP)
- Adoption of FBET process

(): 2SA1370

Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	(-) 200	V
Collector to Emitter Voltage	V_{CEO}	(-) 200	V
Emitter to Base Voltage	V_{EBO}	(-) 5	V
Collector Current	I_C	(-) 100	mA
Peak Collector Current	i_{cp}	(-) 200	mA
Collector Dissipation	P_C	1.0	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

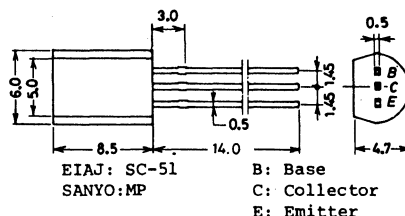
Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-) 150V, I_E = 0$			(-) 0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-) 4V, I_C = 0$			(-) 0.1	μA
DC Current Gain	h_{FE}	$V_{CE} = (-) 10V, I_C = (-) 10mA$	40*		320*	
Gain Bandwidth Product	f_T	$V_{CE} = (-) 30V, I_C = (-) 10mA$		150		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-) 20mA, I_B = (-) 2mA$			(-) 0.6	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = (-) 20mA, I_B = (-) 2mA$			(-) 1.0	V
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C = (-) 10\mu A, I_E = 0$	(-) 200			V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_C = (-) 1mA, R_{BE} = \infty$	(-) 200			V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E = (-) 10\mu A, I_C = \infty$	(-) 5			V
Output Capacitance	c_{ob}	$V_{CB} = (-) 30V, f = 1MHz$		1.7 (2.6)		pF
Reverse Transfer Capacitance	c_{re}	$V_{CB} = (-) 30V, f = 1MHz$		1.2 (1.7)		pF

* : The 2SA1370/2SC3467 are classified by 10mA h_{FE} as follows:

40	C	80	60	D	120	100	E	200	160	F	320
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Case Outline 2006A
(unit:mm)



For details, refer to the description of the 2SC3467.

3135KI/1114KI, MT No.1412-1/4

2SA1371



2006A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3468

High-Definition CRT Display Video Output Applications

©1413B

Use

- Color TV chroma output and high breakdown voltage driver

Features

- High breakdown voltage: $V_{CEO} \geq 300V$
- Small reverse transfer capacitance and excellent high frequency characteristic $c_{re} = 1.8pF$ (NPN), $2.3pF$ (PNP)
- Adoption of MBIT process

(): 2SA1371

Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	(-) 300	V
Collector to Emitter Voltage	V_{CEO}	(-) 300	V
Emitter to Base Voltage	V_{EBO}	(-) 5	V
Collector Current	I_C	(-) 100	mA
Peak Collector Current	i_{cp}	(-) 200	mA
Collector Dissipation	P_C	1.0	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

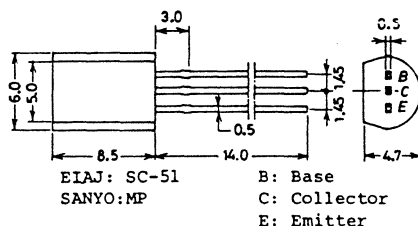
Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-) 200V, I_E = 0$			(-) 0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-) 4V, I_C = 0$			(-) 0.1	μA
DC Current Gain	h_{FE}	$V_{CE} = (-) 10V, I_C = (-) 10mA$	40*		320*	
Gain Bandwidth Product	f_T	$V_{CE} = (-) 30V, I_C = (-) 10mA$		150		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-) 20mA, I_B = (-) 2mA$			(-) 0.6	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = (-) 20mA, I_B = (-) 2mA$			(-) 1.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-) 10\mu A, I_E = 0$	(-) 300			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-) 1mA, R_{BE} = \infty$	(-) 300			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-) 10\mu A, I_C = 0$	(-) 5			V
Output Capacitance	c_{ob}	$V_{CB} = (-) 30V, f = 1MHz$		2.6 (3.1)		pF
Reverse Transfer Capacitance	c_{re}	$V_{CB} = (-) 30V, f = 1MHz$		1.8 (2.3)		pF

* : The 2SA1371/2SC3468 are classified by 10mA h_{FE} as follows:

40	C	80	60	D	120	100	E	200	160	F	320
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Case Outline 2006A
(unit:mm)



For details, refer to the description of the 2SC3468.

2SA1380



2009

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3502

High-Definition CRT Display Video Output Applications

©1425A

Features

- High breakdown voltage: $V_{CE0} \geq 200V$.
- Small reverse transfer capacitance and excellent high frequency characteristic $c_{re} = 1.2pF$ (NPN), $1.7pF$ (PNP) $V_{CB} = 30V$.
- Adoption of FBET process.

Absolute Maximum Ratings at $T_a = 25^\circ C$

Absolute Maximum Ratings at Ta=25°C				unit
Collector to Base Voltage	V _{CBO}	(-)200		V
Collector to Emitter Voltage	V _{CEO}	(-)200		V
Emitter to Base Voltage	V _{EBO}	(-)5		V
Collector Current	I _C	(-)100		mA
Peak Collector Current	i _{cp}	(-)200		mA
Allowable Collector	P _C	1.2		W
Dissipation			T _C =25°C	5 W
Junction Temperature	T _j	150		°C
Storage Temperature	T _{stg}	-55 to +150		°C

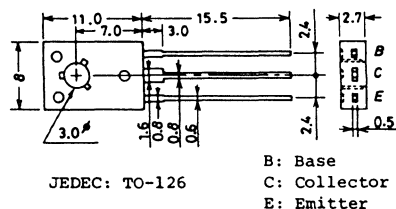
Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-)150V, I_E = 0$		(-)0.1		μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$		(-)0.1		μA
DC Current Gain	h_{FE}	$V_{CE} = (-)10V, I_C = (-)10mA$	40*		320*	
Gain Bandwidth Product	f_T	$V_{CE} = (-)30V, I_C = (-)10mA$		150		MHz
Output Capacitance	c_{ob}	$V_{CB} = (-)30V, f = 1MHz$		1.7		pF
				(2.6)		
Reverse Transfer Capacitance	c_{re}	$V_{CB} = (-)30V, f = 1MHz$		1.2		pF
				(1.7)		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = (-)20mA, I_B = (-)2mA$		(-)0.6		V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C = (-)20mA, I_B = (-)2mA$		(-)1.0		V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-)10\mu A, I_E = 0$	(-)200			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-)200			V
Base to Emitter Breakdown Voltage	$V_{(BR)EBO}$	$I_C = (-)10\mu A, I_C = 0$	(-)5			V

* The 2SA1380/2SC3502 are classified by 10mA h_{FE} as follows:

40	C	80	60	D	120	100	E	200	160	F	320
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Case Outline 2009
(unit:mm)



For details, refer to the description of the 2SC3502.

D134MY, TS No.1425-1/4

PNP/NPN Epitaxial Planar Silicon Transistors

High-Definition CRT Display Video Output Applications

Features

- High breakdown voltage: $V_{CEO} \geq 300V$.
- Small reverse transfer capacitance and excellent high frequency characteristic $c_{re} = 1.8pF(NPN)$, $2.3pF(PNP)$ $V_{CB} = 30V$.
- Adoption of MBIT process.

unit

Collector to Base Voltage	V_{CB0}	(-)300	V
Collector to Emitter Voltage	V_{CE0}	(-)300	V
Emitter to Base Voltage	V_{EB0}	(-)5	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Allowable Collector Dissipation	P_C	1.2	W
	$T_C = 25^\circ\text{C}$	7	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

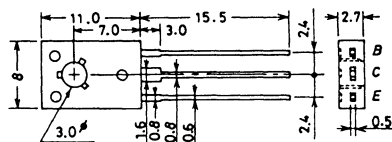
min	typ	max	unit
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Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)200V, I_E=0$	$(-)0.1$	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$	$(-)0.1$	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)10V, I_C=(-)10mA$	40^*	320^*
Gain Bandwidth Product	f_T	$V_{CE}=(-)30V, I_C=(-)10mA$	150	MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)30V, f=1MHz$	2.6	pF
			(3.1)	
Reverse Transfer Capacitance	c_{re}	$V_{CB}=(-)30V, f=1MHz$	1.8	pF
			(2.3)	
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)20mA, I_E=(-)2mA$	$(-)0.6$	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)20mA, I_E=(-)2mA$	$(-)1.0$	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)300$	V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	$(-)300$	V
Base to Emitter Breakdown Voltage	$V_{(BR)EBO}$	$I_C=(-)10\mu A, I_C=0$	$(-)5$	V

* The 2SA1381/2SC3503 are classified by 10mA h_{FE} as follows:

40	C	80	60	D	120	100	E	200	160	F	320
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Case Outline 2009
(unit:mm)



JEDEC: TO-126

B: Base
C: Collector
E: Emitter

D134MY, TS No. 1426-1/4

2SA1402



2009

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3596

Very High-Definition CRT Display Video Output Applications

©1761

Applications

- . Very high-definition CRT display.
- . Video output.
- . Color TV chroma output.
- . Wide-band amp.

Features

- . High f_T . f_T typ=700MHz.
- . Small reverse transfer capacitance and excellent HF response
cre=1.8pF(NPN), 2.3pF(PNP).
- . Complementary PNP and NPN types.
- . Adoption of FBET process.

(): 2SA1402

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)80	V
Collector to Emitter Voltage	V_{CE0}	(-)60	V
Emitter to Base Voltage	V_{EB0}	(-)4	V
Collector Current	I_C	(-)300	mA
Peak Collector Current	i_{cp}	(-)600	mA
Collector Dissipation	P_C	$T_a=25^\circ\text{C}$ 1.2 $T_c=25^\circ\text{C}$ 8	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

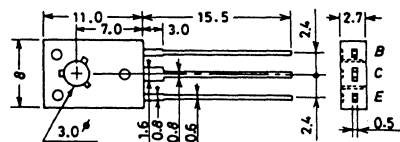
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)60\text{V}, I_E=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)2\text{V}, I_C=0$			(-)1.0	μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$	40		320	
	$h_{FE}(2)$	$V_{CE}=(-)10\text{V}, I_C=(-)250\text{mA}$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)100\text{mA}$		700		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)100\text{mA}, I_E=(-)10\text{mA}$			0.6 (-0.8)	V

* The 2SA1402/2SC3596 are classified by 50mA h_{FE} as follows:

40	C	80	60	D	120
100	E	200	160	F	320

Case Outline 2009
(unit:mm)



JEDEC: TO-126

B: Base
C: Collector
E: Emitter

			min	typ	max	unit
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)100mA, I_E=(-)10mA$			(-)1.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	(-)80			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	(-)60			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)100\mu A, I_C=0$	(-)4			V
Output Capacitance	c_{ob}	$V_{CB}=(-)30V, f=1MHz$		2.3 (3.0)		pF pF
Reverse Transfer Capacitance	c_{re}	$V_{CB}=(-)30V, f=1MHz$		1.8 (2.3)		pF pF

The rest is omitted. For characteristic curves, refer to the description of the 2SC3596.

2SA1403



PNP/NPN Epitaxial Planar
Silicon Transistors

2009

2SC3597

Very High-Definition CRT Display Video Output Applications

©1762

Applications

- . Very high-definition CRT display.
- . Video output.
- . Color TV chroma output.
- . Wide-band amp.

Features

- . High f_T . f_T typ=800MHz.
- . Small reverse transfer capacitance and excellent HF response $c_{re}=2.9pF(NPN)$, $4.6pF(PNP)$.
- . Complementary PNP and NPN types.
- . Adoption of FBET process.

(): 2SA1403

Absolute Maximum Ratings at $T_a=25^\circ C$

Absolute Maximum Ratings at Ta=25°C				unit
Collector to Base Voltage	V _{CB0}	(-)80	V	
Collector to Emitter Voltage	V _{CE0}	(-)60	V	
Emitter to Base Voltage	V _{EB0}	(-)4	V	
Collector Current	I _C	(-)500	mA	
Peak Collector Current	i _{cp}	(-)1	A	
Collector Dissipation	P _C	Ta=25°C Tc=25°C	1.2 10	W
Junction Temperature	T _j		150	°C
Storage Temperature	T _{stg}		-55 to +150	°C

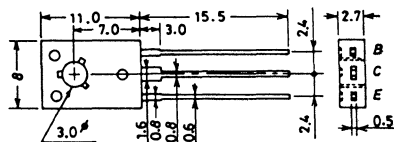
Electrical Characteristics at $T_a=25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)60V, I_E=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)2V, I_C=0$			(-)1.0	μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)10V, I_C=(-)50mA$	40		320	
	$h_{FE}(2)$	$V_{CE}=(-)10V, I_C=(-)400mA$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)100mA$		800		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)100mA, I_B=(-)10mA$			0.6 (-0.8)	V

* The 2SA1403/2SC3597 are classified by 50mA h_{FE} as follows:

40	C	80	60	D	120
100	E	200	160	F	320

Case Outline 2009
(unit:mm)



JEDEC: TO-126

B: Base
C: Collector
E: Emitter

2225MY, TS No. 1762-1/4

			min	typ	max	unit
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)100mA, I_E=(-)10mA$			$(-)1.0$	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)80$			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	$(-)60$			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)100\mu A, I_C=0$	$(-)4$			V
Output Capacitance	c_{ob}	$V_{CB}=(-)30V, f=1MHz$		3.4 (5.2)		pF pF
Reverse Transfer Capacitance	c_{re}	$V_{CB}=(-)30V, f=1MHz$		2.9 (4.6)		pF pF

The rest is omitted. For characteristic curves, refer to the description of the 2SC3597.

2SA1404



2009

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3598

Very High-Definition CRT Display Video Output Applications

©1763

Applications

- . Very high-definition CRT display.
- . Video output.
- . Color TV chroma output.
- . Wide-band amp.

Features

- . High f_T . f_T typ=500MHz.
- . High breakdown voltage. $V_{CEO} \geq 120V$
- . Small reverse transfer capacitance and excellent HF response $c_{re}=1.6pF(NPN)$, $2.1pF(PNP)$.
- . Complementary PNP and NPN types.
- . Adoption of FBET process.

(): 2SA1404

Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	(-)120	V
Collector to Emitter Voltage	V_{CEO}	(-)120	V
Emitter to Base Voltage	V_{EBO}	(-)4	V
Collector Current	I_C	(-)200	mA
Peak Collector Current	i_{cp}	(-)400	mA
Collector Dissipation	P_C	$T_a=25^\circ C$ 1.2 $T_c=25^\circ C$ 8	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a=25^\circ C$

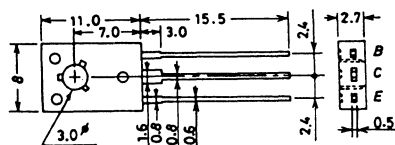
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80V, I_E=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)2V, I_C=0$			(-)1.0	μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)10V, I_C=(-)10mA$	40		320	
	$h_{FE}(2)$	$V_{CE}=(-)10V, I_C=(-)150mA$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		500		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)50mA, I_E=(-)5mA$			0.6 (-0.8)	V

* The 2SA1404/2SC3598 are classified by 10mA h_{FE} as follows:

40	C	80	60	D	120
100	E	200	160	F	320

Case Outline 2009

(unit:mm)



JEDEC: TO-126

B: Base
C: Collector
E: Emitter

2225MY, TS No.1763-1/4

2SA1404/2SC3598

			min	typ	max	unit
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)50mA, I_B=(-)5mA$			$(-)1.0$	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10uA, I_E=0$	$(-)120$			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	$(-)120$			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)100uA, I_C=0$	$(-)4$			V
Output Capacitance	c_{ob}	$V_{CB}=(-)30V, f=1MHz$		2.0 (2.7)		pF
Reverse Transfer Capacitance	c_{re}	$V_{CB}=(-)30V, f=1MHz$		1.6 (2.1)		pF

The rest is omitted. For characteristic curves, refer to the description of the 2SC3598.

2SA1405



2009

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3599

Very High-Definition CRT Display Video Output Applications

©1764

Applications

- . Very high-definition CRT display.
- . Video output.
- . Color TV chroma output.
- . Wide-band amp.

Features

- . High f_T . f_T typ=500MHz.
- . High breakdown voltage. $V_{CEO} \geq 120V$
- . Small reverse transfer capacitance and excellent HF response
 $c_{re}=2.5pF(NPN)$, $3.8pF(PNP)$.
- . Complementary PNP and NPN type.
- . Adoption of FBET process.

(): 2SA1405

Absolute Maximum Ratings at $T_a=25^\circ C$

Absolute Maximum Ratings at Ta=25°C				unit
Collector to Base Voltage	V _{CB0}	(-)120		V
Collector to Emitter Voltage	V _{CE0}	(-)120		V
Emitter to Base Voltage	V _{EB0}	(-)4		V
Collector Current	I _C	(-)300		mA
Peak Collector Current	i _{cp}	(-)600		mA
Collector Dissipation	P _C		Ta=25°C	1.2 W
			Tc=25°C	8 W
Junction Temperature	T _j			150 °C
Storage Temperature	T _{stg}			-55 to +150 °C

Electrical Characteristics at $T_a=25^\circ C$

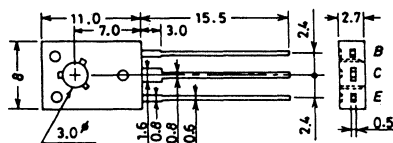
			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)80V, I_E=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)2V, I_C=0$			(-)1.0	μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)10V, I_C=(-)50mA$	40		320	
	$h_{FE}(2)$	$V_{CE}=(-)10V, I_C=(-)250mA$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		500		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)70mA, I_E=(-)7mA$			0.6 (-0.8)	V V

* The 2SA1405/2SC3599 are classified by 50mA h_{FE} as follows:

40	C	80	60	D	120
100	E	200	160	F	320

Case Outline 2009

(unit:mm)



JEDEC: TO-126

B: Base
C: Collector
E: Emitter

2225MY, TS No.1764-1/4

2SA1405/2SC3599

			min	typ	max	unit
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)70mA, I_E=(-)7mA$			(-) 1.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	(-) 120			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	(-) 120			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)100\mu A, I_C=0$	(-) 4			V
Output Capacitance	c_{ob}	$V_{CB}=(-)30V, f=1MHz$		2.9		pF
				(4.3)		pF
Reverse Transfer Capacitance	c_{re}	$V_{CB}=(-)30V, f=1MHz$		2.5		pF
				(3.8)		pF

The rest is omitted. For characteristic curves, refer to the description of the 2SC3599.

2SA1406



2009

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3600

Very High-Definition CRT Display Video Output Applications

©1765

Applications

- . Very high-definition CRT display.
- . Video output.
- . Color TV chroma output.
- . Wide-band amp.

Features

- . High f_T . f_T typ=400MHz.
- . High breakdown voltage. $V_{CEO} \geq 200V$
- . Small reverse transfer capacitance and excellent HF response $c_{re}=1.4pF(NPN)$, $1.7pF(PNP)$.
- . Complementary PNP and NPN types.
- . Adoption of FBET process.

(): 2SA1406

Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	(-)200	V
Collector to Emitter Voltage	V_{CEO}	(-)200	V
Emitter to Base Voltage	V_{EBO}	(-)4	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	$T_a=25^\circ C$	1.2 W
		$T_c=25^\circ C$	7 W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a=25^\circ C$

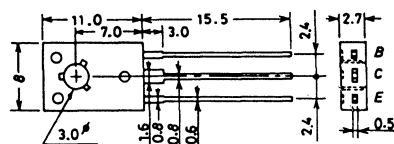
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)150V, I_E=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)2V, I_C=0$			(-)1.0	μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)10V, I_C=(-)10mA$	40		320	
	$h_{FE}(2)$	$V_{CE}=(-)10V, I_C=(-)60mA$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)30V, I_C=(-)30mA$		400		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)30mA, I_B=(-)3mA$			0.6	V
					(-0.8)	V

* The 2SA1406/2SC3600 are classified by 10mA h_{FE} as follows:

40	C	80	60	D	120
100	E	200	160	F	320

Case Outline 2009

(unit:mm)



JEDEC: TO-126

B: Base
C: Collector
E: Emitter

2SA1406/2SC3600

			min	typ	max	unit
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)30mA, I_E=(-)3mA$			(-)1.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	(-)200			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	(-)200			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)100\mu A, I_C=0$	(-)4			V
Output Capacitance	c_{ob}	$V_{CB}=(-)30V, f=1MHz$		1.8 (2.3)		pF
Reverse Transfer Capacitance	c_{re}	$V_{CB}=(-)30V, f=1MHz$		1.4 (1.7)		pF

The rest is omitted. For characteristic curves, refer to the description of the 2SC3600.

2SA1407



2009

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3601

Very High-Definition CRT Display Video Output Applications

©1766

Applications

- . Very high-definition CRT display.
- . Video output.
- . Color TV chroma output.
- . Wide-band amp.

Features

- . High f_T . f_T typ=400MHz.
- . High breakdown voltage. $V_{CEO} \geq 200V$
- . Small reverse transfer capacitance and excellent HF response $c_{re}=2.0pF(NPN)$, $2.5pF(PNP)$.
- . Complementary PNP and NPN types.
- . Adoption of FBET process.

(): 2SA1407

Absolute Maximum Ratings at $T_a=25^\circ C$

Absolute Maximum Ratings at Ta=25°C				unit
Collector to Base Voltage	V _{CBO}	(-)200	V	
Collector to Emitter Voltage	V _{CEO}	(-)200	V	
Emitter to Base Voltage	V _{EBO}	(-)4	V	
Collector Current	I _C	(-)150	mA	
Peak Collector Current	i _{cp}	(-)300	mA	
Collector Dissipation	P _C	Ta=25°C	1.2	W
		Tc=25°C	7	W
Junction Temperature	T _j		150	°C
Storage Temperature	T _{stg}		-55 to +150	°C

Electrical Characteristics at $T_a=25^\circ C$

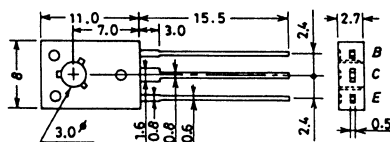
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)150V, I_E=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)2V, I_C=0$			(-)1.0	μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)10V, I_C=(-)10mA$	40		320	
	$h_{FE}(2)$	$V_{CE}=(-)10V, I_C=(-)100mA$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)30V, I_C=(-)50mA$		400		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)50mA, I_B=(-)5mA$			0.6 (-0.8)	V V

* The 2SA1407/2SC3601 are classified by 10mA h_{FE} as follows:

40	C	80	60	D	120
100	E	200	160	F	320

Case Outline 2009

(unit:mm)



JEDEC: TO-126

B: Base
C: Collector
E: Emitter

			min	typ	max	unit
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)50mA, I_B=(-)5mA$			$(-)1.0$	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)200$			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	$(-)200$			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)100\mu A, I_C=0$	$(-)4$			V
Output Capacitance	c_{ob}	$V_{CB}=(-)30V, f=1MHz$		2.5 (3.0)		pF pF
Reverse Transfer Capacitance	c_{re}	$V_{CB}=(-)30V, f=1MHz$		2.0 (2.5)		pF pF

2SA1415



2038

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3645

High Voltage Switching, Predriver Applications

©1720

Features

- Adoption of FBET process.
- High breakdown voltage ($V_{CE0}=160V$)
- Excellent linearity of h_{FE} and small c_{ob} .
- Fast switching speed.
- Very small size making it easy to provide high-density, small-sized hybrid IC's

(): 2SA1415

Absolute Maximum Ratings at $T_a=25^{\circ}C$

			unit
Collector to Base Voltage	V_{CBO}	(-)180	V
Collector to Emitter Voltage	V_{CEO}	(-)160	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)140	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	$P_C(1)$	500	mW
	$P_C(2)$ Mounted on ceramic board (250mm ² x 0.8mm)	1.3	W
Junction Temperature	T_j	150	$^{\circ}C$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}C$

Electrical Characteristics at $T_a=25^{\circ}C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80V, I_E=0$			(-)100	nA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$			(-)100	nA
DC Current Gain	h_{FE}^*	$V_{CE}=(-)5V, I_C=(-)10mA$	100		400	
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)10mA$		150		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10V, f=1MHz$		(4.0)		pF
				3.0		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)50mA, I_B=(-)5mA$		(-0.14)(-0.4)		V
				0.07	0.3	
Turn-ON Time	t_{on}	at specified Test Circuit		0.1		us
Storage Time	t_{stg}	"		1.5		us
Fall Time	t_f	"		0.1		us

* The 2SA1415/2SC3645 are classified by 10mA h_{FE} as follows:

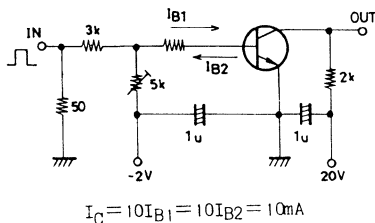
100	R	200	140	S	280	200	T	400
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Marking

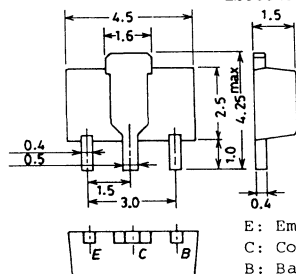
2SA1415-----AA

2SC3645-----CA

Switching Time Test Circuit



Case Outline 2038-PCP (unit:mm)



E: Emitter
C: Collector
B: Base

SANYO: PCP

For details, refer to the description of the 2SC3645.

2SA1418



2038

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3648

High Voltage Switching Applications

©1788

Applications

- Color TV audio output, converter, inverter.

Features

- Adoption of FBET, MBIT processes.
- High breakdown voltage and large current capacity.
- Fast switching speed.
- Very small size making it easy to provide high-density, small-sized hybrid IC's.

(): 2SA1418

Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V _{CBO}	(-)180	V
Collector to Emitter Voltage	V _{CEO}	(-)160	V
Emitter to Base Voltage	V _{EBO}	(-)6	V
Collector Current	I _C	(-)0.7	A
Peak Collector Current	i _{cp}	(-)1.5	A
Collector Dissipation	P _C	500	mW
	P _C Mounted on ceramic board (250mm ² x0.8mm)	1.3	W
Junction Temperature	T _j	150	°C
Storage Temperature	T _{stg}	-55 to +150	°C

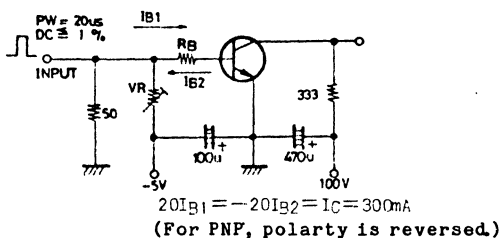
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I _{CBO}	V _{CB} =(-)120V, I _E =0			(-)0.1	uA
Emitter Cutoff Current	I _{EBO}	V _{EB} =(-)4V, I _C =0			(-)0.1	uA
DC Current Gain	h _{FE} (1)*	V _{CE} =(-)5V, I _C =(-)100mA	100		400	
	h _{FE} (2)	V _{CE} =(-)5V, I _C =(-)10mA	90			
Gain Bandwidth Product	f _T	V _{CE} =(-)10V, I _C =(-)50mA		120		MHz
C-E Saturation Voltage	V _{CE(sat)}	I _C =(-)250mA, I _B =(-)25mA		0.12	0.4	
				(-0.2)(-0.5)		V
B-E Saturation Voltage	V _{BE(sat)}	I _C =(-)250mA, I _B =(-)25mA		(-)0.85	(-)1.2	V
C-B Breakdown Voltage	V _{(BR)CBO}	I _C =(-)10uA, I _E =0		(-)180		V
C-E Breakdown Voltage	V _{(BR)CEO}	I _C =(-)1mA, R _{BE} =∞		(-)160		V
E-B Breakdown Voltage	V _{(BR)EBO}	I _E =(-)10uA, I _C =0		(-)6		V

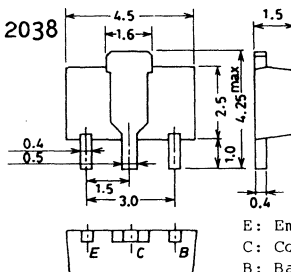
* The 2SA1418/2SC3648 are classified by 100mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400
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Switching Time Test Circuit



Case Outline 2038 (unit:mm)



Marking
2SA1418: AD
2SC3648: CD

E: Emitter
C: Collector
B: Base

SANYO: PCP

2SA1418/2SC3648

			min	typ	max	unit
Output Capacitance	c_{ob}	$V_{CB}=(-)10V, f=1MHz$		8 (11)		pF pF
Turn-ON Time	t_{on}	at specified test circuit		50 (60)		ns ns
Storage Time	t_{stg}	"		1000 (900)		ns ns
Fall Time	t_f	"		60 (60)		ns ns

The rest is omitted. For characteristic curves, refer to the description of the 2SC3648.

2SA1420



2003A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3653

Switching Applications (with Bias Resistance)

Ⓔ1682

Use

- Switching circuit, inverter circuit, interface circuit, driver circuit

Features

- With bias resistor ($R_1=47\text{kohm}$, $R_2=47\text{kohm}$).

(): 2SA1420

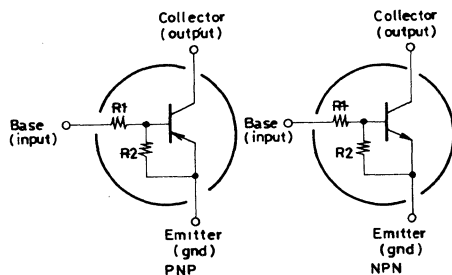
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)50	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)10	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	400	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

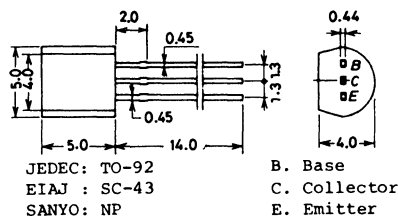
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			(-)0.1	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}, I_B=0$			(-)0.5	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$	(-)30	(-)53	(-)80	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}, I_C=(-)5\text{mA}$	50			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		3.7 (5.5)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{mA}, I_B=(-)0.25\text{mA}$	(-)0.1	(-)0.3		V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)50			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu\text{A}, R_{BE}=\infty$	(-)50			V

Electrical Connection

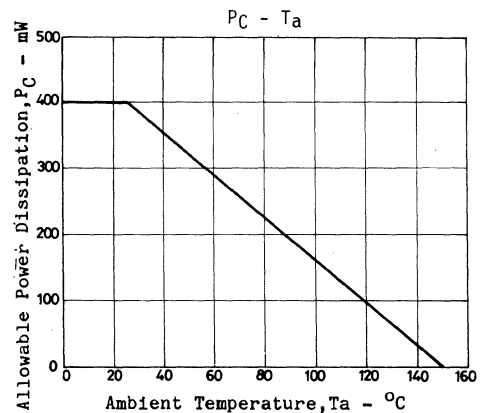
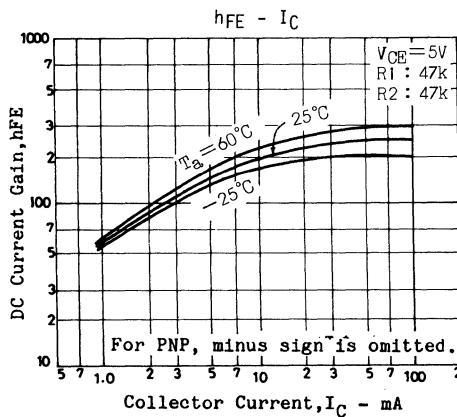
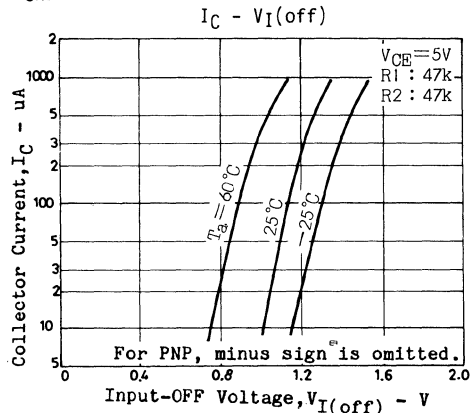
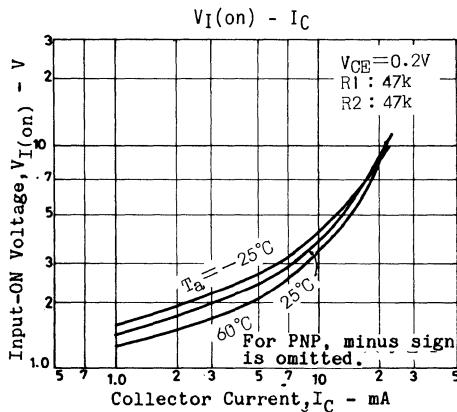
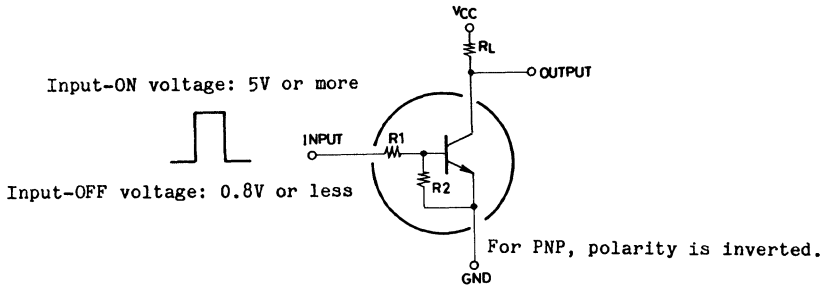


Case Outline 2003A (unit:mm)



		min	typ	max	unit
Input-OFF Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	$(-)0.8$	$(-)1.1$	$(-)1.5$ V
Input-ON Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)5mA$	$(-)1.0$	$(-)2.5$	$(-)5.0$ V
Input Resistance	R_1		32	47	62 kohm
Resistance Ratio	R_1/R_2		0.9	1.0	1.1 -

Sample Application Circuit



2SA1421



2003A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3654

Switching Applications (with Bias Resistance)

©1683

Use

- Switching circuit, inverter circuit, interface circuit, driver circuit

Features

- With bias resistor ($R_1=22\text{kohm}$, $R_2=22\text{kohm}$).

(): 2SA1421

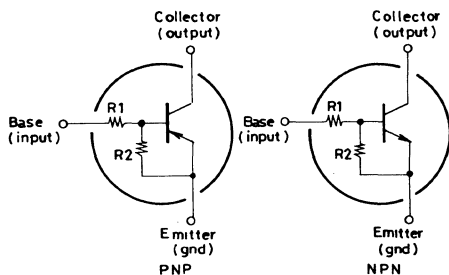
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)50	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)10	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	400	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

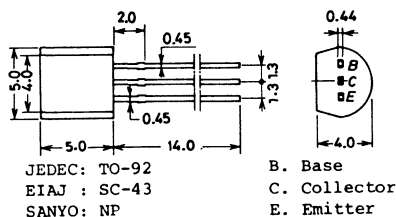
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)40\text{V}, I_E=0$		(-)0.1		μA
Collector Cutoff Current	I_{CE0}	$V_{CE}=(-)40\text{V}, I_B=0$		(-)0.5		μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)5\text{V}, I_C=0$	(-)70	(-)113	(-)150	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}, I_C=(-)5\text{mA}$	50			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		3.7 (5.5)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)10\text{mA}, I_B=(-)0.5\text{mA}$	(-)0.1	(-)0.3		V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)50			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu\text{A}, R_{BE}=\infty$	(-)50			V

Electrical Connection

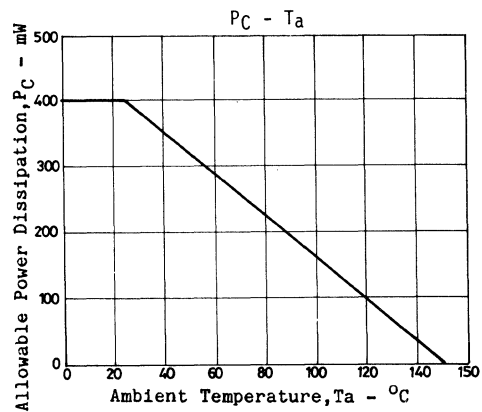
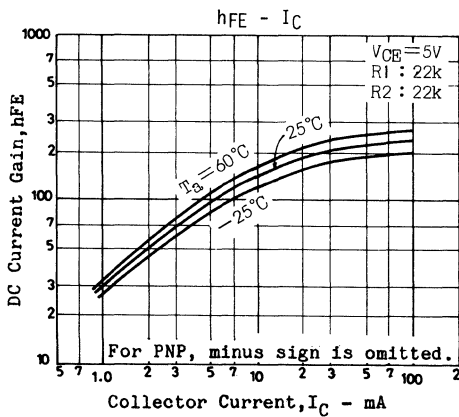
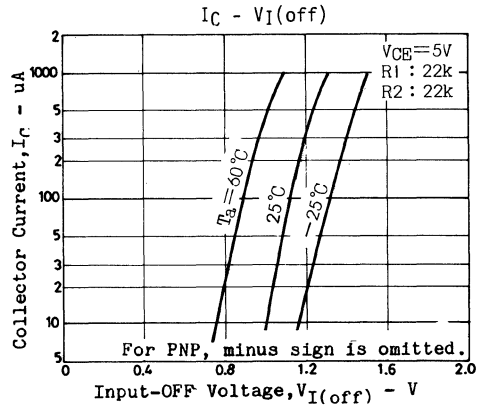
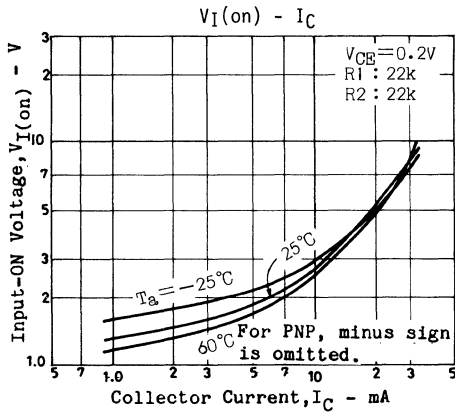
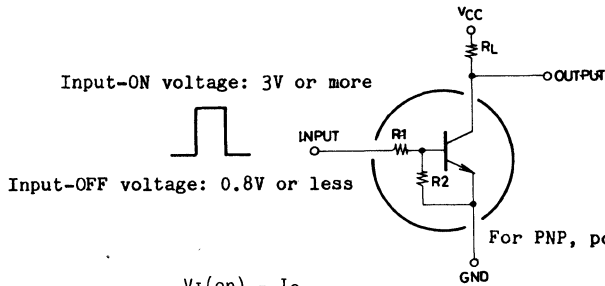


Case Outline 2003A (unit:mm)



			min	typ	max	unit
Input-OFF Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	(-0.8)	(-1.1)	(-1.5)	V
Input-ON Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)5mA$	(-1.0)	(-1.9)	(-3.0)	V
Input Resistance	R_1		15	22	29	kohm
Resistance Ratio	R_1/R_2		0.9	1.0	1.1	-

Sample Application Circuit



2SA1422



2003A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3655

Switching Applications (with Bias Resistance)

©1684

Use

. Switching circuit, inverter circuit, interface circuit, driver circuit

Features

. With bias resistor ($R_1=46\text{kohm}$, $R_2=23\text{kohm}$).

(): 2SA1422

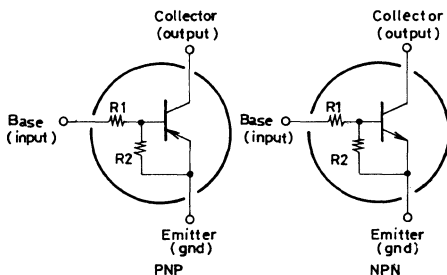
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)50	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)10	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	400	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

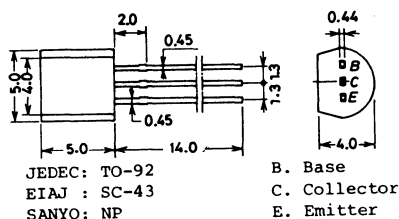
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)40\text{V}, I_E=0$		(-)0.1		μA
Collector Cutoff Current	I_{CE0}	$V_{CE}=(-)40\text{V}, I_B=0$		(-)0.5		μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)5\text{V}, I_C=0$	(-)40	(-)72	(-)100	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}, I_C=(-)5\text{mA}$	50			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		3.7 (5.5)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{mA}, I_B=(-)0.25\text{mA}$	(-)0.1	(-)0.3		V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)50			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu\text{A}, R_{BE}=\infty$	(-)50			V

Electrical Connection

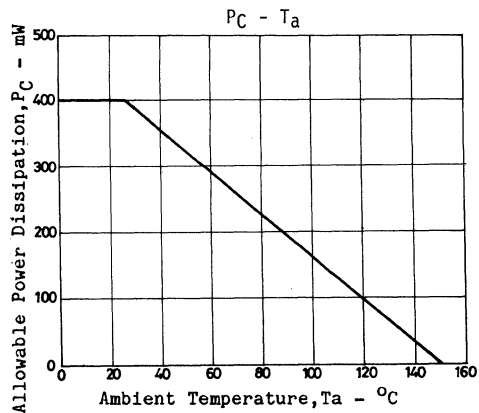
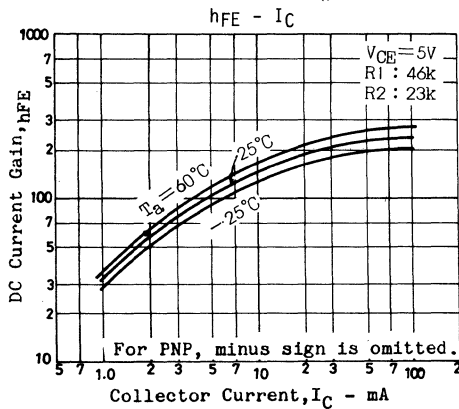
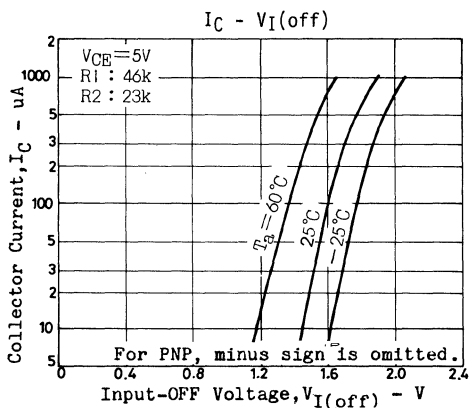
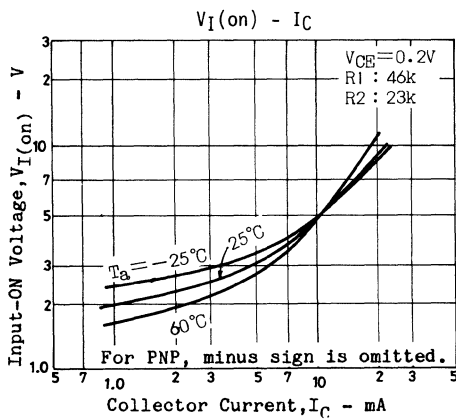
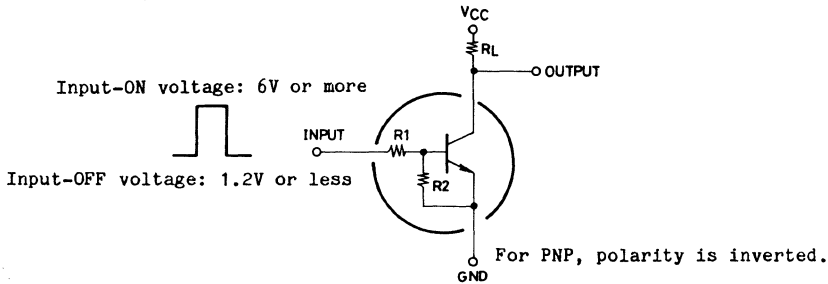


Case Outline 2003A (unit:mm)



			min	typ	max	unit
Input-OFF Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	(-)1.2	(-)1.6	(-)2.3	V
Input-ON Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)5mA$	(-)1.5	(-)3.1	(-)6.0	V
Input Resistance	R_1		32	46	60	kohm
Resistance Ratio	R_1/R_2		1.8	2.0	2.2	-

Sample Application Circuit



2SA1423



2003A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SC3656

Switching Applications (with Bias Resistance)

©1685

Use

- Switching circuit, inverter circuit, interface circuit, driver circuit

Features

- With bias resistor ($R_1=10\text{kohm}$, $R_2=10\text{kohm}$).

(): 2SA1423

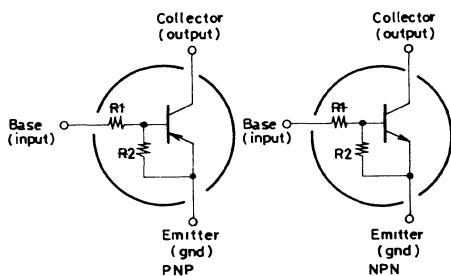
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)50	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)10	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	400	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

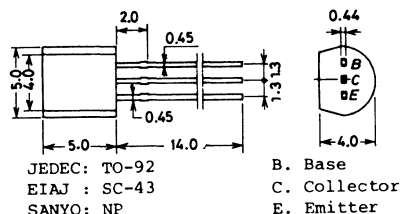
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)40\text{V}, I_E=0$		(-)0.1		μA
Collector Cutoff Current	I_{CE0}	$V_{CE}=(-)40\text{V}, I_B=0$		(-)0.5		μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)5\text{V}, I_C=0$	(-)170	(-)250	(-)330	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}, I_C=(-)10\text{mA}$	50			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	C_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		3.7 (5.5)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)10\text{mA}, I_B=(-)0.5\text{mA}$	(-)0.1	(-)0.3		V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)50			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu\text{A}, R_{BE}=\infty$	(-)50			V

Electrical Connection

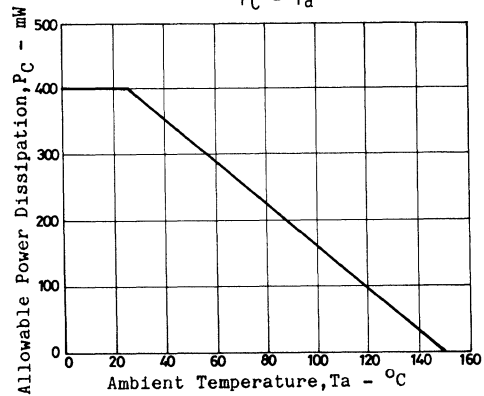
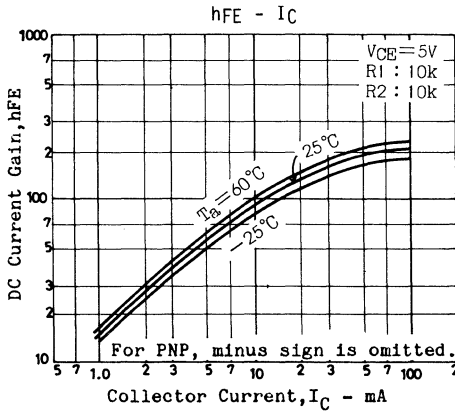
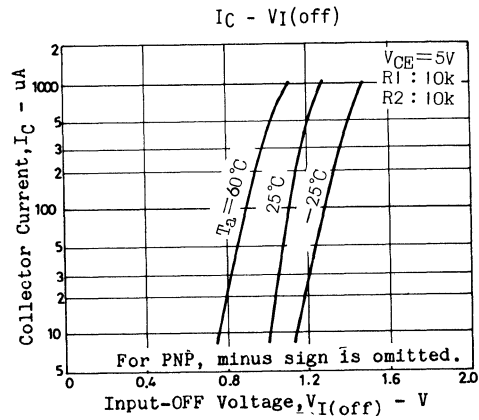
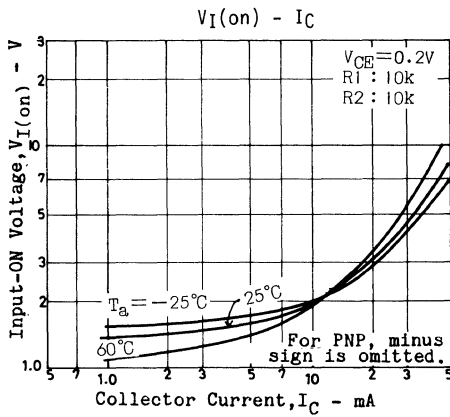
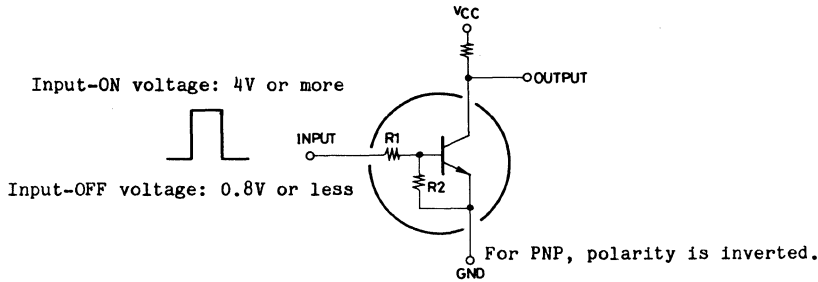


Case Outline 2003A (unit:mm)



			min	typ	max	unit
Input-OFF Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	(-)0.8	(-)1.1	(-)1.5	V
Input-ON Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)10mA$	-1.0	(-)2.0	(-)4.0	V
Input Resistance	R_1		7.0	10	13	kohm
Resistance Ratio	R_1/R_2		0.9	1.0	1.1	-

Sample Application Circuit

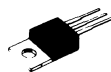


2SB-TYPE (LF PNP)

	Page		Page
2SB507	177	2SB881	205
2SB508	177	2SB882	206
2SB511	178	2SB883	207
2SB514	179	2SB884	208
2SB515	179	2SB885	209
2SB544	180	2SB886	210
2SB559	181	2SB887	211
2SB560	182	2SB888	212
2SB598	183	2SB892	214
2SB631	184	2SB893	215
2SB631K	184	2SB903	218
2SB632	185	2SB904	219
2SB632K	185	2SB912	220
2SB633	186	2SB913	221
2SB698	188	2SB919	222
2SB764	189	2SB920L	223
2SB775	190	2SB921L	224
2SB776	192	2SB922L	225
2SB808	193	2SB926	226
2SB815	194	2SB927	227
2SB816	195	2SB985	228
2SB817	196	2SB986	229
2SB824	197	2SB1037	230
2SB825	198	2SB1118	231
2SB826	199	2SB1119	232
2SB827	200	2SB1120	233
2SB828	201	2SB1121	236
2SB829	202	2SB1123	238
2SB865	203	2SB1126	240
2SB880	204		

All specifications and characteristics shown on the following pages are for standard products. Data shown on individual figures, except P_C derating curve and ASO, are represented by typical values. Ambient temperature T_a is 25°C unless otherwise specified.

2SB507, 508



2010A



2012

PNP/NPN Triple Diffused Planar
Silicon Transistors

2SD313, 314

Low Frequency Power Amp Applications

©396D

- .2SB507, 2SB508 and 2SD313, 2SD314 are complementary pairs respectively.
- .These are designed for the output stage of 15W to 25W AF power amplifier.
- .2SB507 and 2SB508, or 2SD313 and 2SD314, differ from their case outlines only.
- () shows the case of 2SB507, 2SB508 only.

Absolute Maximum Ratings at Ta=25°C

Collector to Base Voltage	VCBO	(-) 60	V
Collector to Emitter Voltage	VCEO	(-) 60	V
Emitter to Base Voltage	VEBO	(-) 5	V
Collector Current	IC	(-) 3	A
	icp	(-) 8	A
Collector Dissipation	PC	1.75	W
	(Tc=25°C)	30	W
Junction Temperature	Tj	150	°C
Storage Temperature	Tstg	-40 to +150	°C

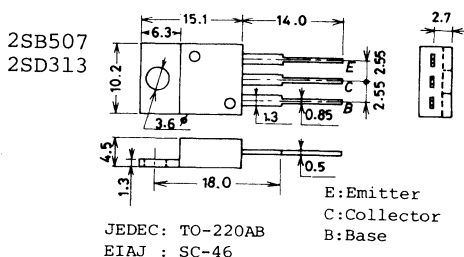
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cut Off Current	ICBO	VCB=(-) 20V, IE=0			(-) 0.1	mA
	ICEO	VCE=(-) 60V, RBE=∞			(-) 5	mA
Emitter Cut Off Current	IEBO	VEB=(-) 4V, IC=0			(-) 1	mA
Secondary Breakdown Voltage	VS/B	IC=(-) 0.5A, t=1sec	(-) 60			V
DC Current Gain	*hFE(1)	VCE=(-) 2V, IC=(-) 1A	40*		320*	
	hFE(2)	VCE=(-) 2V, IC=(-) 0.1A	40			
Gain Band Width Product	fT	VCE=(-) 5V, IC=(-) 0.5A		8		MHz
Output Capacitance	cob	(VCB=(-) 10V, f=1MHz)		(130)		pF
				65		pF
C-E Saturation Voltage	VCE(sat)	IC=(-) 2A, IB=(-) 0.2A	(-) 0.4	(-) 1.0		V
Base to Emitter Voltage	VBE	IC=(-) 1A, VCE=(-) 2V		(-) 1.5		V

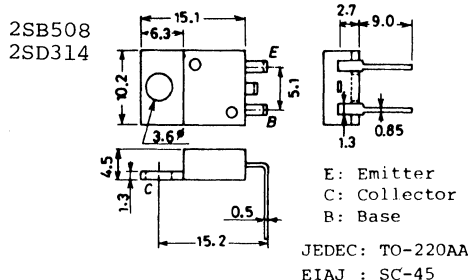
* 2SB507, 508/2SD313, 314 are classified by (-) 1A hFE as follows:

40	C	80	60	D	120	100	E	200	160	F	320
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Case Outline 2010A
(unit:mm)

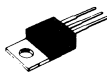


Case Outline 2012
(unit:mm)



For details, refer to the description of the 2SD313, 314.

2SB511



2010A

PNP/NPN Triple Diffused Planar
Silicon Transistors**2SD325**

Low Frequency Power Amp Applications

E398E

. 5 watts AF power amplifier output use. There are complementary pair.

(): 2SB511

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

Collector to Base Voltage	V_{CB0}	(-) 35	V
Collector to Emitter Voltage	V_{CE0}	(-) 35	V
Emitter to Base Voltage	V_{EB0}	(-) 5	V
Collector Current	I_C	(-) 1.5	A
Peak Collector Current	i_{cp}	(-) 3	A
Collector Dissipation	P_C	1.75	W
		$T_c=25^{\circ}\text{C}$	
		10	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-40 to +150	$^{\circ}\text{C}$

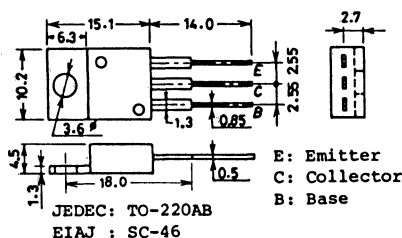
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

		min	typ	max	unit
Collector Cutoff Current	I_{CBO} $V_{CB}=(-) 20\text{V}, I_E=0$			(-) 0.1	mA
Emitter Cutoff Current	I_{EBO} $V_{EB}=(-) 4\text{V}, I_C=0$			(-) 1.0	mA
DC Current Gain	$h_{FE}(1)$ $*V_{CE}=(-) 2\text{V}, I_C=(-) 1\text{A}$	40*		320*	
	$h_{FE}(2)$ $V_{CE}=(-) 2\text{V}, I_C=(-) 0.1\text{A}$	35			
Gain Bandwidth Product	f_T $V_{CE}=(-) 5\text{V}, I_C=(-) 0.5\text{A}$		8		MHz
C-E Saturation Voltage	$V_{CE(sat)}$ $I_C=(-) 1.5\text{A}, I_B=(-) 0.15\text{A}$		(-) 1.0		V
Base to Emitter Voltage	V_{BE} $I_C=(-) 1\text{A}, V_{CE}=(-) 5\text{V}$		(-) 1.5		V

* Classified by 2V 1A h_{FE} as follows :

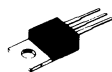
40	C	80	60	D	120	100	E	200	160	F	320
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Case Outline 2010A (unit:mm)



For details, refer to the description of the 2SD325.

2SB514, 515



2010A



2012

PNP/NPN Triple Diffused Planar
Silicon Transistors

2SD330, 331

Low Frequency Power Amp Applications

©397C

- Especially suited for use in output stage of 10W AF Power amp. The only difference between B514 and D515 lies in package design; and the same is true of D330 and D331. The B514 and D330 can be connected to form a complementary pair; and the same is true of B515 and D331.

():2SB514,514.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)50	V
Collector to Emitter Voltage	V_{CEO}	(-)50	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)2	A
Peak Collector Current	i_{cp}	(-)5	A
Collector Dissipation	P_C	1.75	W
	($T_C=25^\circ\text{C}$)	20	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to +150	$^\circ\text{C}$

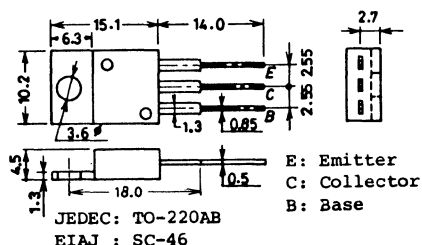
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)20\text{V}, I_E=0$		(-)0.1		mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$		(-)1.0		mA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)2\text{V}, I_C=(-)1\text{A}$	40*		320*	
	$h_{FE}(2)$	$V_{CE}=(-)2\text{V}, I_C=(-)0.1\text{A}$	35			
Gain Bandwidth Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)0.5\text{A}$		8		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)2\text{A}, I_B=(-)0.2\text{A}$		(-)1.0		V
Base to Emitter Voltage	V_{BE}	$I_C=(-)1\text{A}, V_{CE}=(-)5\text{V}$		(-)1.5		V

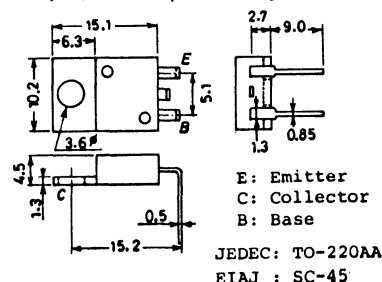
* Classified by 2V 1A h_{FE} as follows :

40	C	80	60	D	120	100	E	200	160	F	320
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Case Outline 2010A
(unit:mm) [2SB514/2SD330]



Case Outline 2012
(unit:mm) [2SB515/2SD331]



For details, refer to the description of the 2SD330, 331.



2006A

PNP/NPN Epitaxial Planar Silicon Transistors

2SD400

Low Frequency Power Amp, Electronic Governor Applications

©199H

(): 2SB544

Absolute Maximum Ratings at Ta=25°C

Absolute Maximum Ratings at Ta=25°C			unit
Collector to Base Voltage	V _{CBO}	(-)25	V
Collector to Emitter Voltage	V _{CEO}	(-)25	V
Emitter to Base Voltage	V _{EBO}	(-)5	V
Collector Current	I _C	(-)1	A
Peak Collector Current	i _{cp}	(-)2	A
Collector Dissipation	P _C	900	mW
Junction Temperature	T _j	150	°C
Storage Temperature	T _{stg}	-55 to +150	°C

Electrical Characteristics at Ta=25°C

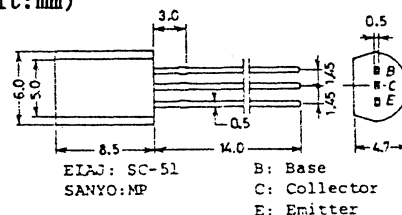
Electrical Characteristics at $T_a=25^{\circ}\text{C}$		min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{\text{CB}}=(-)20\text{V}, I_{\text{E}}=0$		$(-)1.0$	μA
Emitter Cutoff Current	I_{EBO}	$V_{\text{EB}}=(-)4\text{V}, I_{\text{C}}=0$		$(-)1.0$	μA
DC Current Gain	$h_{\text{FE}}(1)$	$V_{\text{CE}}=(-)2\text{V}, I_{\text{C}}=(-)50\text{mA}$	60		
	$h_{\text{FE}}(2)$	$V_{\text{CE}}=(-)2\text{V}, I_{\text{C}}=(-)1\text{A}$	30		
		Pulse Test			
Gain Bandwidth Product	f_{T}	$V_{\text{CE}}=(-)10\text{V}, I_{\text{C}}=(-)50\text{mA}$	180		MHz
			(25)		
Output Capacitance	c_{ob}	$V_{\text{CB}}=(-)10\text{V}, f=1\text{MHz}$	15		pF
			$(-0.15)(-0.7)$		
Collector to Emitter Saturation Voltage	$V_{\text{CE}}(\text{sat})$	$I_{\text{C}}=(-)500\text{mA}, I_{\text{B}}=(-)50\text{mA}$	0.1	0.3	V
Base to Emitter Saturation Voltage	$V_{\text{BE}}(\text{sat})$	$I_{\text{C}}=(-)500\text{mA}, I_{\text{B}}=(-)50\text{mA}$	$(-)0.85$	$(-)1.2$	V
Collector to Base Breakdown Voltage	$V_{(\text{BR})\text{CBO}}$	$I_{\text{C}}=(-)10\mu\text{A}, I_{\text{E}}=0$	$(-)25$		V
Collector to Emitter Breakdown Voltage	$V_{(\text{BR})\text{CEO}}$	$I_{\text{C}}=(-)1\text{mA}, R_{\text{BE}}=\infty$	$(-)25$		V
Emitter to Base Breakdown Voltage	$V_{(\text{BR})\text{EBO}}$	$I_{\text{E}}=(-)10\mu\text{A}, I_{\text{C}}=0$	$(-)5$		V

* The 2SB544/2SD400 are classified by 50mA h_{FE} as follows:

60	D	120	100	E	200	160	F	320	280	G	560
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Case Outline 2006A

(unit:mm)



For details, refer to the description of the 2SD400.

D174MY, TS No.C199H/No, E103-1/5

2SB559



2009

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD439

Low Frequency Power Amp, Medium Speed Switching Applications

©372D

Features

- Large allowable collector dissipation and wide ASO.
- Low saturation voltage and good linearity of h_{FE} .
- Suited for use in output stage of low-voltage high-output ($P_o=2W/V_{CC}=4.5V$) AF amp.

():2SB559

Absolute Maximum Ratings at $T_a=25^{\circ}C$

			unit
Collector to Base Voltage	V_{CBO}	(-)20	V
Collector to Emitter Voltage	V_{CEO}	(-)18	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)1.2	A
Peak Collector Current	i_{cp}	(-)2.0	A
Collector Dissipation	P_C	1	W
		8	W
		150	$^{\circ}C$
Junction Temperature	T_j		
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}C$

$T_c=25^{\circ}C$

Electrical Characteristics at $T_a=25^{\circ}C$

			min	typ	max	unit
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	(-)20			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	(-)18			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu A, I_C=0$	(-)5			V
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)15V, I_E=0$			(-)1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$			(-)1	μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)2V, I_C=(-)500mA$	60*		320*	
	$h_{FE}(2)^*$	$V_{CE}=(-)2V, I_C=(-)1.5A$	(40)50			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		150		MHz
Collector Capacitance	c_{ob}	$V_{CB}=(-)10V, f=1MHz$	(30)20			pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)1A, I_B=(-)50mA$	(-0.35)	(-0.7)		V
			0.25	0.5		V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500mA, I_B=(-)50mA$	(-)0.85	(-)1.2		V
Turn-ON Time	t_{on}	At specified Test Circuit		50		ns
Storage Time	t_{stg}	"		(60)70		ns
Fall Time	t_f	"		200		ns

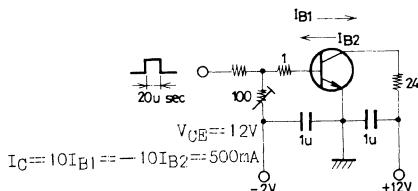
* The 2SB559/2SD439 are classified by h_{FE} at 500mA.

60	D	120	100	E	200	160	F	320
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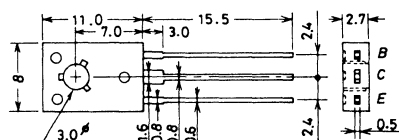
Case Outline 2009

(unit:mm)

Switching Time Test Circuit



(For PNP, polarity is reversed)



JEDEC: TO-126

B: Base
C: Collector
E: Emitter

For details, refer to the description of the 2SD439.

2SB560



2006A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD438

Low Frequency Power Amp Applications

©326F

The 2SB560/2SD438 are epitaxial planar transistors for complementary push-pull pair having high reverse voltage and low saturation voltage, and suitable universal AF power amplifier use.

():2SB560

Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CB0}	(-)100	V
Collector to Emitter Voltage	V_{CE0}	(-)80	V
Emitter to Base Voltage	V_{EB0}	(-)5	V
Collector Current	I_C	(-)0.7	A
Peak Collector Current	i_{cp}	(-)1.0	A
Collector Dissipation	P_C	900	mW
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

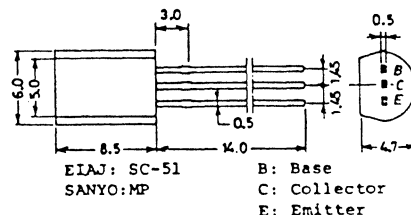
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)20V, I_E=0$			(-)1.0	uA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$			(-)1.0	uA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=(-)5V, I_C=(-)50mA$	*60		*560	
	$h_{FE}(2)$	$V_{CE}=(-)5V, I_C=(-)0.5A$	30			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		100		MHz
Output Capacitance	c_{ob}	$V_{CE}=(-)10V, f=1MHz$		(15)		pF
				10		pF
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10uA$	(-)100			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, R_{BE}=\infty$	(-)80			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_C=(-)10uA, I_C=0$	(-)5			V
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500mA, I_B=(-)50mA$		(-0.3)	(-0.8)	V
				0.2	0.6	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500mA, I_B=(-)50mA$	(-)0.85	(-)1.2		V

* The 2SB560/2SD438 are classified by (-)50mA h_{FE} as follows.

60	D	120	100	E	200	160	F	320	280	G	560
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Case Outline 2006A (unit:mm)



For details, refer to the description of the 2SD438.

3085MY, TS No.326-1/3

2SB598



2003A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD545

AF Power Amp, Converter, Electronic Governor Applications

Ⓔ268G

The 2SB598NP/2SD545NP are complementary pair transistors that are packaged in small packages and are large in current capacity and excellent in saturation characteristic and h_{FE} linearity. In addition to the above application areas, they are also suited for use in desk-top calculator power supplies, relay drivers.

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

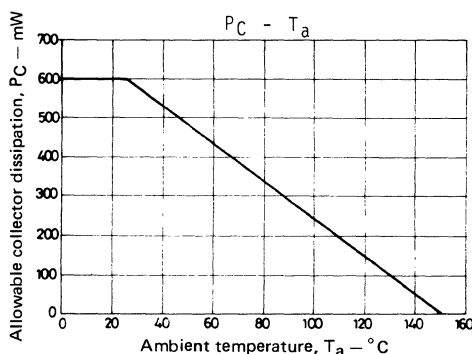
		2SB598	2SD545	unit
Collector to base voltage	V_{CBO}	-25	25	V
Collector to emitter voltage	V_{CEO}	-25	25	V
Emitter to base voltage	V_{EBO}	-5	5	V
Collector current	I_C	-1.0	1.0	A
	i_{cp}	-1.5	1.5	A
Collector dissipation	P_C	600	600	mW
Junction temperature	T_j	150	150	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ~ +150	-55 ~ +150	$^\circ\text{C}$

Electrical Characteristics/ $T_a = 25^\circ\text{C}$

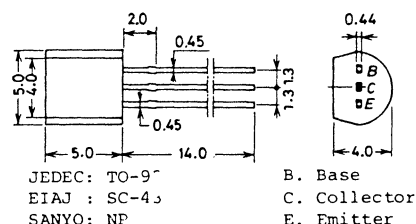
			2SB598		2SD545		unit
			min	typ	min	typ	
Collector cutoff current	I_{CBO}	$V_{CB} = (-)20\text{V}, I_E = 0$		max -1.0		1.0	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = (-)4\text{V}, I_C = 0$		-1.0		1.0	μA
Collector to base breakdown voltage	$V_{(BR)CBO}$	$I_C = (-)10\mu\text{A}, I_E = 0$	-25		25		V
Collector to emitter breakdown voltage	$V_{(BR)CEO}$	$I_C = (-)1\text{mA}, R_{BE} = \infty\Omega$	-25		25		V
Emitter to base breakdown voltage	$V_{(BR)EBO}$	$I_E = (-)10\mu\text{A}, I_C = 0$	-5		5		V
DC current gain	$h_{FE}(1)^*$	$V_{CE} = (-)2\text{V}, I_C = (-)50\text{mA}$	60	560	60	560	
	$h_{FE}(2)$	$V_{CE} = (-)2\text{V}, I_C = (-)1\text{A}(\text{pulse})$	30		30		
Gain bandwidth product	f_T	$V_{CE} = (-)10\text{V}, I_C = (-)50\text{mA}$		180		180	MHz
Common base output capacitance	c_{ob}	$V_{CB} = (-)10\text{V}, f = 1\text{MHz}$		25		15	pF
Collector to emitter saturation voltage	$V_{CE(sat)}$	$I_C = (-)500\text{mA}, I_B = (-)50\text{mA}$	-0.15	-0.5	0.1	0.3	V
Base to emitter saturation voltage	$V_{BE(sat)}$	$I_C = (-)500\text{mA}, I_B = (-)50\text{mA}$	-0.85	-1.2	0.85	1.2	V

* $h_{FE}(1)$ is classified by 2 V, 50 mA as follows:

60 D 120	100 E 200	160 F 320	280 G 560
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Case Outline 2003A (unit:mm)



For details, refer to the description of the 2SD545.

2SB631, 631K



2009

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD600, 600K

Low Frequency Power Amp, Medium Speed Switching Applications

Ⓔ346E

Features

- High breakdown voltage V_{CE0} 100/120V, high current 1A.
- Low saturation voltage and good linearity of h_{FE} .

(): 2SB631,631K

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

	2SB631,D600	2SB631K,D600K	unit
Collector to Base Voltage	V_{CB0} (-) 100	(-) 120	V
Collector to Emitter Voltage	V_{CE0} (-) 100	(-) 120	V
Emitter to Base Voltage	V_{EB0}	(-)5	V
Collector Current	I_C	(-)1	A
Peak Collector Current	i_{cp}	(-)2	A
Collector Power Dissipation	P_C	1	W
	$T_C=25^{\circ}\text{C}$	8	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

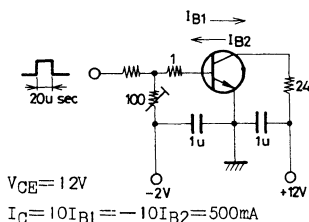
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

		min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$ ($I_C=(-)10\mu\text{A}$, $I_E=0$)	B631,D600 (-)100			V
		B631K,D600K (-)120			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$ ($I_C=(-)1\text{mA}$, $R_{BE}=\infty$)	B631,D600 (-)100			V
		B631K,D600K (-)120			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$ ($I_E=(-)10\mu\text{A}$, $I_C=0$)	(-)5			V
Collector Cutoff Current	I_{CBO} ($V_{CB}=(-)50\text{V}$, $I_E=0$)			(-)1	μA
Emitter Cutoff Current	I_{EBO} ($V_{EB}=(-)4\text{V}$, $I_C=0$)			(-)1	μA
DC Current Gain	$h_{FE(1)}$ ($V_{CE}=(-)5\text{V}$, $I_C=(-)50\text{mA}$)	60*		320*	
	$h_{FE(2)}$ ($V_{CE}=(-)5\text{V}$, $I_C=(-)500\text{mA}$)	20			
Gain Bandwidth Product	f_T ($V_{CE}=(-)10\text{V}$, $I_C=(-)50\text{mA}$)		(110)		MHz
			130		
Output Capacitance	c_{ob} ($V_{CB}=(-)10\text{V}$, $f=1\text{MHz}$)		(30)		pF
			20		

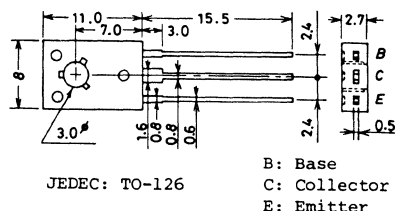
* The 2SB631,2SD600 are classified by 50mA h_{FE} as follows:

60	D	120	100	E	200	160	F	320
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Switching Time Test Circuit



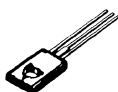
Case Outline 2009 (unit:mm)



For details, refer to the description of the 2SD600, 600K.

D144MY, TS/E107 No.346-1/3

2SB632, 632K



2009

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD612, 612K

Low Frequency Power Amp, Medium Speed Switching Applications

©341E

Features

- Large allowable collector dissipation and wide ASO.

(): 2SB632, 632K

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

		2SB632, D612	2SB632K, D612K	unit
Collector to Base Voltage	V_{CB0}	(-) 25	(-) 35	V
Collector to Emitter Voltage	V_{CE0}	(-) 25	(-) 35	V
Emitter to Base Voltage	V_{EB0}	(-) 5	(-) 2	V
Collector Current	I_C	(-) 3	(-) 2	A
	i_{cp}	(-) 3	(-) 2	A
Collector Dissipation	P_C	1	10	W
		$T_C=25^{\circ}\text{C}$	150	$^{\circ}\text{C}$
Junction Temperature	T_j	150		$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150		$^{\circ}\text{C}$

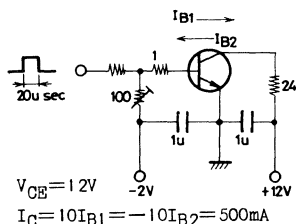
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}$ $I_E=0$	(-) 25			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}$ $R_{BE}=\infty$	(-) 25			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$	(-) 5			V
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)20\text{V}, I_E=0$			(-) 1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-) 1	μA
DC Current Gain	$h_{FE(1)}$	$V_{CE}=(-)2\text{V}, I_C=(-)500\text{mA}$	60*		320*	
	$h_{FE(2)}$	$V_{CE}=(-)2\text{V}, I_C=(-)1.5\text{A}$	30			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		100		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(30 (45)		pF

* 2SB632, 2SD612 are classified by 500mA h_{FE} as follows:

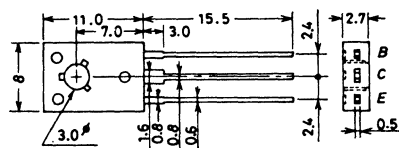
60	D	120	100	E	200	160	F	320
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Switching Time Test Circuit



Case Outline 2009

(unit:mm)

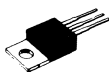


JEDEC: TO-126

B: Base
C: Collector
E: Emitter

For details, refer to the description of the 2SD612, 612K.

2SB633



2010A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD613

High Voltage Switching, AF 25 to 35W Output Applications

Ⓔ513E

(): 2SB633

Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CB0}	(-)100	V
Collector to Emitter Voltage	V_{CE0}	(-)85	V
Emitter to Base Voltage	V_{EB0}	(-)6	V
Collector Current	I_C	(-)6	A
Peak Collector Current	i_{cp}	(-)10	A
Collector Dissipation	P_C	40	W
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

$T_C=25^\circ\text{C}$

Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)40\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	mA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$	40*		320*	
	$h_{FE}(2)$	$V_{CE}=(-)5\text{V}, I_C=(-)3\text{A}$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$		15		MHz
C-E Saturation Voltage	$V_{CE}(\text{sat})$	$I_C=(-)4\text{A}, I_E=(-)0.4\text{A}$			(-)2.0	V
B-E Rise Voltage	V_{BE}	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$			(-)1.5	V
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(150)		pF
				110		pF
C-B Breakdown Voltage	$V_{(BR)CB0}$	$I_C=(-)5\text{mA}, I_E=0$	(-)100			V
C-E Breakdown Voltage	$V_{(BR)CE0}$	$I_C=(-)5\text{mA}, R_{BE}=\infty$	(-)85			V
	"	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)85			V
E-B Breakdown Voltage	$V_{(BR)EB0}$	$I_E=(-)5\text{mA}, I_C=0$	(-)6			V

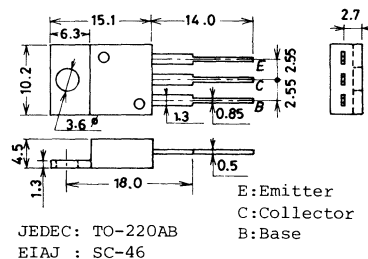
* The 2SB633/2SD613 are classified by 1A h_{FE} as follows:

40	C	80	60	D	120	100	E	200	160	F	320
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.The switching time characteristic and test circuit are shown on next page.

Case Outline 2010A

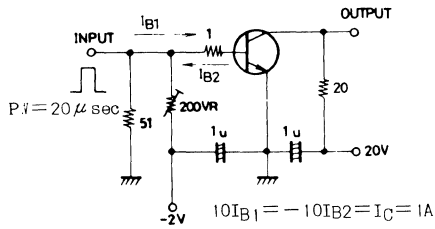
(unit:mm)



2SB633/2SD613

			min	typ	max	unit
Turn-on Time	t_{on}	at Test Circuit shown below		(0.16)		usec
				0.28		
Fall Time	t_f	"		(1.45)		usec
				3.60		
Storage Time	t_{stg}	"		(0.33)		usec
				0.50		

Switching Time Test Circuit



The rest is omitted. For characteristic curves, refer to the description of the 2SD613.

2SB698



2003A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD734

AF 1W Output, Electronic Governor, D-D Converter Applications

Ⓔ512E

() : 2SB698 for audio 1W output.

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)25	V
Collector to Emitter Voltage	V_{CEO}	(-)20	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)0.7	A
Peak Collector Current	i_{cp}	(-)1.5	A
Collector Dissipation	P_C	0.6	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

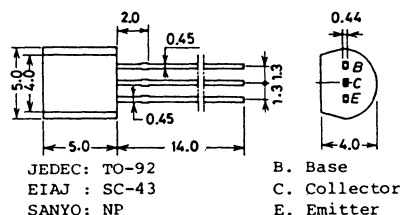
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)20\text{V}, I_E=0$		(-)1.0		μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$		(-)1.0		μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)2\text{V}, I_C=(-)50\text{mA}$	60*		560*	
	$h_{FE}(2)$	$V_{CE}=(-)2\text{V}, I_C=(-)500\text{mA}$	50			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		250		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(13)		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500\text{mA}, I_B=(-)50\text{mA}$	-0.2	-0.45		V
			0.13	0.3		V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500\text{mA}, I_B=(50\text{mA})$		(-)0.9		V
C-B Saturation Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$		(-)25		V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$		(-)20		V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_C=(-)10\mu\text{A}, I_C=0$		(-)5		V

*2SB698 and 2SD734 are graded as follows by h_{FE} at 1A :

60	D	120	100	E	200	160	F	320	280	G	560
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Case Outline 2003A (unit:mm)



For details, refer to the description of the 2SD734.

2SB764



2006A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD863

**Voltage Regulator, Relay-Lamp Driver,
Electrical Equipment Applications**

©575C

():2SB764

Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CBO}	(-)60	V
Collector to Emitter Voltage	V_{CEO}	(-)50	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)1	A
Peak Collector Current	i_{cp}	(-)2	A
Collector Dissipation	P_C	0.9	W
Junction Temperature	T_J	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

Electrical Characteristics at Ta=25°C

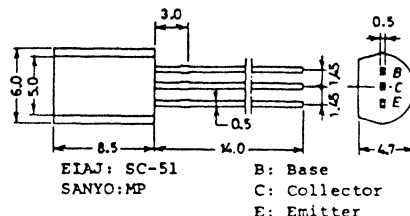
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)50V, I_E=0$			(-)1	uA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$			(-)1	uA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)2V, I_C=(-)50mA$	60*		320*	
	$h_{FE}(2)$	$V_{CE}=(-)2V, I_C=(-)1A$	30			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)5QmA$		150		MHz
Output Capacitance	c_{ob}	$V_{CE}=(-)10V, f=1MHz$		(20)		pF
				12		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500mA, I_E=(-)50mA$	(-0.2)	(-0.7)		V
			0.15	0.5		V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500mA, I_E=(-)50mA$	(-)0.85	(-)1.2		V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10uA, I_E=0$	(-)60			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	(-)50			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_C=(-)10uA, I_C=0$	(-)5			V

* The 2SB764/2SD863 are classified by 50mA h_{FE} as follows.

60	D	120	100	E	200	160	F	320
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Case Outline 2006A

(unit:mm)



For details, refer to the description of the 2SD863.

2SB775



2022

PNP/NPN Planar
Silicon Transistors

2SD895

AF 35W Output Applications

©679D

Features

- Wide ASO because of on-chip ballast resistance.
- Capable of being mounted easily because of one-point fixing type plastic molded package (Interchangeable with T0-3).
- Large current capacity ($I_C=6A$)
- Highly resistant to breakdown.

(): 2SB775

Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CB0}	(-)100	V
Collector to Emitter Voltage	V_{CE0}	(-)85	V
Emitter to Base Voltage	V_{EB0}	(-)6	V
Collector Current	I_C	(-)6	A
Peak Collector Current	i_{cp}	(-)10	A
Collector Dissipation	P_C	60	W
Junction Temperature	T_J	150	$^\circ C$
Storage Temperature	T_{stg}	-40 to +150	$^\circ C$

$T_C=25^\circ C$

Electrical Characteristics at $T_a=25^\circ C$

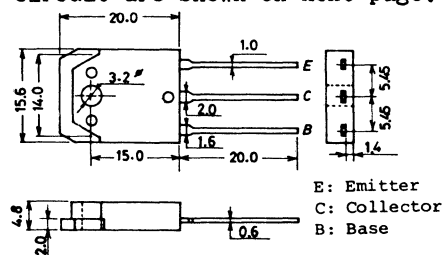
			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)40V, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)4V, I_C=0$			(-)0.1	mA
DC Current Gain	$h_{FE(1)}^*$	$V_{CE}=(-)5V, I_C=(-)1A$	60*		200*	
	$h_{FE(2)}$	$V_{CE}=(-)5V, I_C=(-)3A$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)5V, I_C=(-)1A$		(18)		MHz
				15		
Output Capacitance	c_{ob}	$V_{CB}=(-)10V, f=1MHz$		160		pF
B-E Voltage	V_{BE}	$V_{CE}=(-)5V, I_C=(-)1A$			(-)1.5	V
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)4A, I_B=(-)0.4A$		(-1.4)	(-2.0)	V
				0.9	2.0	
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5mA, I_E=0$	(-)100			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)5mA, R_{BE}=\infty$	(-)85			V
		$I_C=(-)50mA, R_{BE}=\infty$	(-)85			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)5mA, I_C=0$	(-)6			V

* The 2SB775/2SD895 are classified by 1A h_{FE} as follows:

60	D	120	100	E	200
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.The switching time characteristic and test circuit are shown on next page.

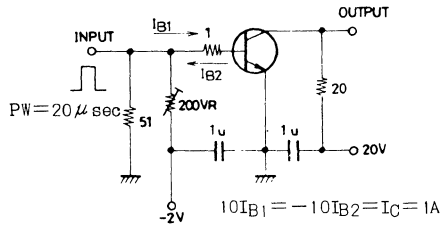
Case Outline 2022
(unit:mm)



E: Emitter
C: Collector
B: Base

			min	typ	max	unit
Turn-on Time	t_{on}	at Test Circuit shown below		(0.12)		usec
				0.20		
Fall Time	t_f	"		(0.36)		usec
				0.82		
Storage Time	t_{stg}	"		(1.29)		usec
				3.88		

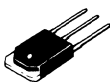
Switching Time Test Circuit



(For PNP, polarity is reversed.)

The rest is omitted. For characteristic curves, refer to the description of the 2SD895.

2SB776



2022

PNP/NPN Planar
Silicon Transistors

2SD896

AF 40W Output Applications

Ⓔ678D

Features

- Capable of being mounted easily because of one-point fixing type plastic molded package (Interchangeable with TO-3).
- Wide ASO because of on-chip ballast resistance.
- Good dependence of f_T on current and excellent HF response.

(): 2SB776

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)120	V
Collector to Emitter Voltage	V_{CE0}	(-)100	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)7	A
Peak Collector Current	i_{cp}	(-)11	A
Collector Dissipation	P_C	70	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to +150	$^\circ\text{C}$

$T_C=25^\circ\text{C}$

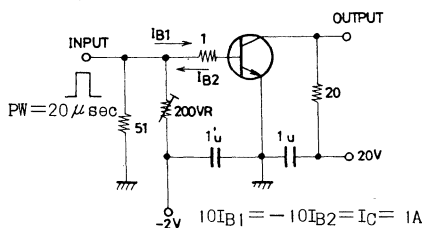
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	mA
DC Current Gain	$h_{FE(1)}$	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$	60*		200*	
	$h_{FE(2)}$	$V_{CE}=(-)5\text{V}, I_C=(-)4\text{A}$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$		15		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(200)		pF
				140		
B-E Voltage	V_{BE}	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$			1.5	V
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)4\text{A}, I_B=(-)0.4\text{A}$		(0.9)		V
				0.6	2.0	
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)120			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)5\text{mA}, R_{BE}=\infty$	(-)100			V
		$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)100			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)5\text{mA}, I_C=0$	(-)6			V

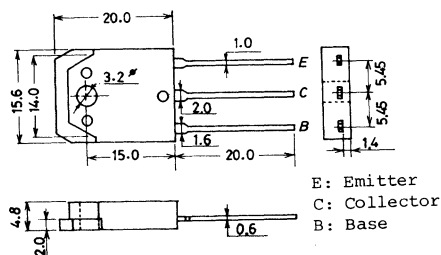
* 2SB776/2SD896 are classified by 1A h_{FE} as follows:

60	D	120	100	E	200
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Switching Time Test Circuit



Case Outline 2022 (unit:mm)



For details, refer to the description of the 2SD896.

1115MY, TS No.678-1/4

2SB808



2000B

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1012

3V, 4.5V AF Amp, Low Voltage, High Current Amp Applications

Ⓔ676B

():2SB808

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

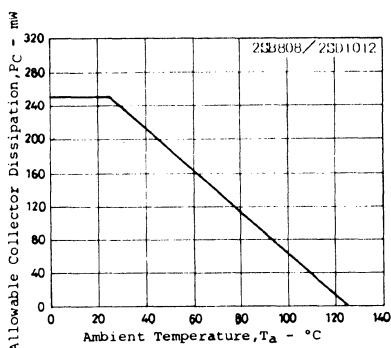
			unit
Collector to Base Voltage	V_{CB0}	(-)20	V
Collector to Emitter Voltage	V_{CE0}	(-)15	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)0.7	A
Peak Collector Current	i_{cp}	(-)1.5	A
Collector Dissipation	P_C	250	mW
Junction Temperature	T_j	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +125	$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

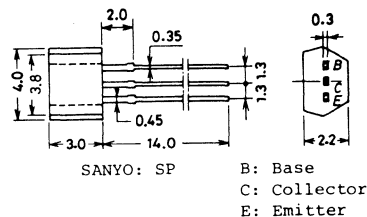
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)15\text{V}, I_E=0$		(-)1.0		μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$		(-)1.0		μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)2\text{V}, I_C=(-)50\text{mA}$	160*		960*	
	$h_{FE}(2)$	$V_{CE}=(-)2\text{V}, I_C=(-)500\text{mA}$	80			
		Pulse				
Gain Band-width Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		250		MHz
Common Base Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(13)		pF
				8		
Collector to Emitter Saturation Voltage	$V_{CE(sat)1}$	$I_C=(-)5\text{mA}, I_B=(-)0.5\text{mA}$		(-15)	(-35)	mV
	$V_{CE(sat)2}$	$I_C=(-)100\text{mA}, I_B=(-)10\text{mA}$		(-60)	(-120)	mV
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)100\text{mA}, I_B=(-)10\text{mA}$		(-0.8)	(-1.2)	V
Collector to Base Breakdown Voltage	$V_{(BR) CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)20			V
Collector to Emitter Breakdown Voltage	$V_{(BR) CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	(-)15			V
Emitter to Base Breakdown Voltage	$V_{(BR) EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$	(-)5			V

* The 2SB808/2SD1012 are classified by 50mA h_{FE} as follows :

2SB808	160	F	320	280	G	560	
2SD1012	160	F	320	280	G	560	480 H 960



Case Outline 2000B
(unit:mm)



For details, refer to the description of the 2SD1012.

2SB815

2018

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1048

Low Frequency General-Purpose Amp Applications

Ⓔ694C

Features

- Very small package enabling compactness and slimness of sets
- Large current capacity ($I_C = 0.7A$) and low saturation voltage

(): 2SB815

Absolute Maximum Ratings/ $T_a = 25^\circ C$

			unit
Collector to base voltage	V_{CBO}	(-)-20	V
Collector to emitter voltage	V_{CEO}	(-)-15	V
Emitter to base voltage	V_{EBO}	(-)-5	V
Collector current	I_C	(-)-0.7	A
Peak collector current	i_{cp}	(-)-1.5	A
Collector dissipation	P_C	200	mW
Junction temperature	T_j	125	$^\circ C$
Storage temperature	T_{stg}	-55 ~ +125	$^\circ C$

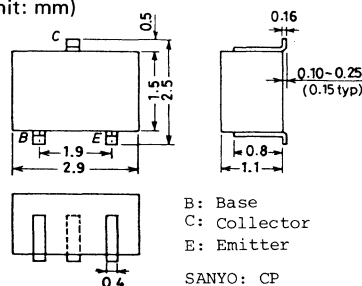
Electrical Characteristics/ $T_a = 25^\circ C$

			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = (-)45V, I_E = 0$			(-)-0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$			(-)-0.1	μA
DC current gain	$h_{FE}(1)$	$V_{CE} = (-)2V, I_C = (-)50 mA$	200*		900*	
	$h_{FE}(2)$	$V_{CE} = (-)2V, I_C = (-)500 mA$	80			
Gain band-width product	f_T	$V_{CE} = (-)10V, I_C = (-)50 mA$		250		MHz
Output capacitance	c_{ob}	$V_{CB} = (-)10V, f = 1 MHz$		(13)		pF
				8		pF
Collector to emitter saturation voltage	$V_{CE(sat)}(1)$	$I_C = (-) 5 mA, I_B = (-) 0.5 mA$	(-)-15	(-)-35		mV
			10	25		mV
	$V_{CE(sat)}(2)$	$I_C = (-) 100 mA, I_B = (-) 10 mA$	(-)-60	(-)-120		mV
			30	80		mV

*: The 2SB815, 2SD1048 are classified by 50 mA h_{FE} as follows:

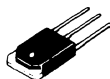
2SB815	200	B6	400	300	B7	600			
2SD1048	200	X6	400	300	X7	600	450	X8	900

Case Outline 2018
(unit: mm)



For details, refer to the description of the 2SD1048.

2SB816



2022

PNP/NPN Planar
Silicon Transistors

2SD1046

AF 50W Output Applications

(E)677C

Features

- Capable of being mounted easily because of one-point fixing type plastic molded package (Interchangeable with TO-3)
- Wide ASO because of built-in ballast resistance
- Good dependence of f_T on current and good HF characteristic

() : 2SB816

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)150	V
Collector to Emitter Voltage	V_{CEO}	(-)120	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)8	A
Peak Collector Current	i_{cp}	(-)12	A
Collector Dissipation	P_C	$T_c=25^\circ\text{C}$ 80	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to +150	$^\circ\text{C}$

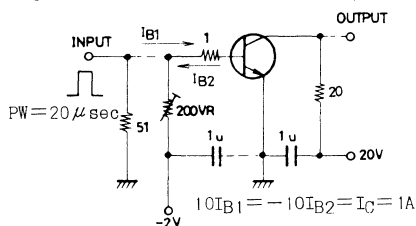
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	mA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$	60*		200*	
	$h_{FE}(2)$	$V_{CE}=(-)5\text{V}, I_C=(-)5\text{A}$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$		15		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(220) 160		pF
Base to Emitter Voltage	V_{BE}	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$			1.5	V
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{A}, I_B=(-)0.5\text{A}$		1.0	2.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)150			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)5\text{mA}, R_{BE}=\infty$	(-)120			V
		$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)120			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)5\text{mA}, I_C=0$	(-)6			V
Turn-on Time	t_{on}	At specified	(0.22)	0.22		usec
Fall Time	t_f	test circuit	(0.37)	1.02		usec
Storage Time	t_{stg}		(0.93)	6.66		usec

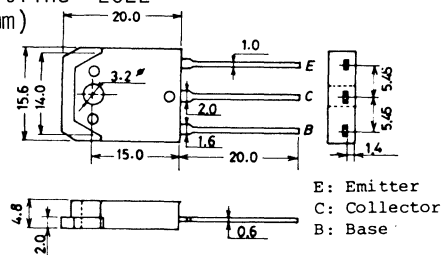
* The 2SB816/2SD1046 are classified by 1A h_{FE} as follows:

60	D	120	100	E	200
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Switching Time Test Circuit



Case Outline 2022 (unir:mm)



For details, refer to the description of the 2SD1046.

2SB817



2022

PNP/NPN Planar
Silicon Transistors

2SD1047

AF 60W Output Applications

©680D

Features

- Capable of being mounted easily because of one-point fixing type plastic molded package (Interchangeable with TO-3)
- Wide ASO because of built-in ballast resistance
- Good dependence of f_T on current and good HF characteristic

(): 2SB817

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)160	V
Collector to Emitter Voltage	V_{CEO}	(-)140	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)12	A
Peak Collector Current	i_{cp}	(-)15	A
Collector Dissipation	P_C	$T_C=25^\circ\text{C}$	100 W
Junction Temperature	T_j		150 $^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to +150	$^\circ\text{C}$

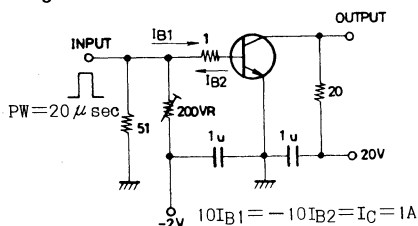
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	mA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$	60*		200*	
	$h_{FE}(2)$	$V_{CE}=(-)5\text{V}, I_C=(-)6\text{A}$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$		15		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(300) 210		pF
Base to Emitter Voltage	V_{BE}	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$			1.5	V
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{A}, I_B=(-)0.5\text{A}$		(1.1)		V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)160			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)5\text{mA}, R_{BE}=\infty$	(-)140			V
		$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)140			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)5\text{mA}, I_C=0$	(-)6			V
Turn-on Time	t_{on}	At specified	(0.25)	0.26		usec
Fall Time	t_f	test circuit	(0.53)	0.68		usec
Storage Time	t_{stg}		(1.61)	6.88		usec

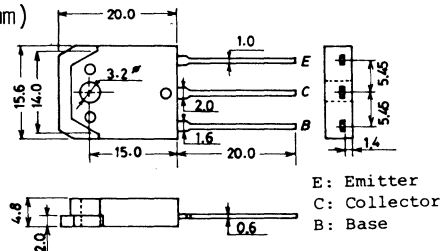
* The 2SB817/2SD1047 are classified by 1A h_{FE} as follows:

60	D	120	100	E	200
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Switching Time Test Circuit

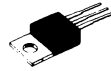


Case Outline 2022 (unit:mm)



For details, refer to the description of the 2SD1047.

2SB824



2010A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1060

High Current Switching Applications

©686G

APPLICATIONS

- Suitable for relay drivers, high-speed inverters, converters, and other general large-current switching

FEATURES

- Low collector-emitter saturation voltage: $V_{CE(sat)} = (-)0.4V$ max/ $I_C = (-)3A$, $I_B = (-)0.3A$

Values for 2SB824 shown in ()

ABSOLUTE MAXIMUM RATINGS/ $T_a = 25^\circ C$

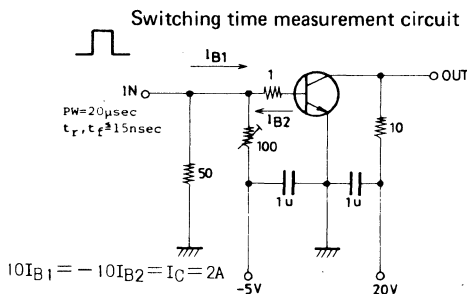
			unit
Collector to base voltage	V_{CBO}	(-)60	V
Collector to emitter voltage	V_{CEO}	(-)50	V
Emitter to base voltage	V_{EBO}	(-)6	V
Collector current	I_C	(-)5	A
Peak collector current	i_{cp}	(-)9	A
Allowable collector dissipation	P_C	30	W
Junction temperature	T_j	150	$^\circ C$
Storage ambient temperature	T_{stg}	-55~+150	$^\circ C$

ELECTRICAL CHARACTERISTICS/ $T_a = 25^\circ C$

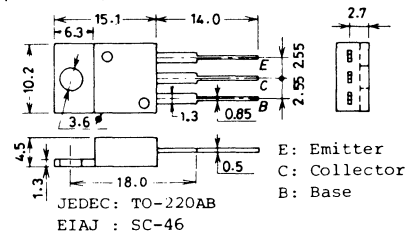
			min	typ	max	unit
Collector cut-off current	I_{CBO}	$V_{CB} = (-)40V, I_E = 0$			(-)0.1	mA
Emitter cut-off current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$			(-)0.1	mA
DC current gain	$h_{FE}(1)^*$	$V_{CE} = (-)2V, I_C = (-)1A$	70*		280*	
	$h_{FE}(2)$	$V_{CE} = (-)2V, I_C = (-)3A$	30			
Gain bandwidth product	f_T	$V_{CE} = (-)5V, I_C = (-)1A$		30		MHz
Output capacitance	c_{ob}	$V_{CB} = (-)10V, f = 1MHz$		100		pF
				(160)		pF
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C = (-)3A, I_B = (-)0.3A$			(-)0.4	V
Collector-base breakdown voltage	$V_{(BR)CBO}$	$I_C = (-)1mA, I_E = 0$	(-)60			V
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-)50			V
Emitter-base breakdown voltage	$V_{(BR)EBO}$	$I_E = (-)1mA, I_C = 0$	(-)6			V
Turn-on time	t_{on}	at the appointed circuit		0.1		μs
Storage time	t_{stg}	at the appointed circuit	(0.7)	1.4		μs
Fall time	t_f	at the appointed circuit		0.2		μs

* 2SB824 and 2SD1060 are graded as follows by h_{FE} at 1A:

70	Q	140	100	R	200	140	S	280
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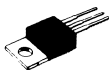


Case outline 2010A
(unit: mm)



For details, refer to the description of the 2SD1060.

No. EC686G-1/3



2010A

PNP/NPN Epitaxial Planar Silicon Transistors

2SD1061

High Current Switching Applications

⑥687E

Use : Universal high current switching as solenoid driving, high speed inverter and converter.

Features

- . Low saturation voltage : $V_{CE(sat)} = (-) 0.4V$ max.
 . Wide ASO.
) 2SB825

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

Collector to Base Voltage	V_{CBO}	(-) 60	V
Collector to Emitter Voltage	V_{CEO}	(-) 50	V
Emitter to Base Voltage	V_{EBO}	(-) 6	V
Collector Current	I_C	(-) 7	A
Peak Collector Current	i_{cp}	(-) 12	A
Collector Dissipation	P_C	40	W
Junction Temperature	T_j	150	$^{\circ}C$
Storage Temperature	T_{sta}	-55 to +150	$^{\circ}C$

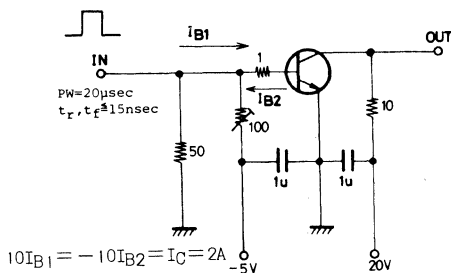
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$			min	typ	max	unit
Collector Cut off Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			(-)0.1	mA
Emitter Cut off Current	I_{EBO}	$V_{EBO}=(-)4\text{V}, I_C=0$			(-)0.1	mA
DC Current Gain	$h_{FE}(1)*$	$V_{CE}=(-)2\text{V}, I_C=(-)1\text{A}$	70*		280*	
	$h_{FE}(2)$	$V_{CE}=(-)2\text{V}, I_C=(-)5\text{A}$	30			
Gain Bandwidth Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$		10		MHz
C-E Saturation Voltage	$V_{CE}(\text{sat})$	$I_C=(-)4\text{A}, I_B=(-)0.4\text{A}$			(-)0.4	V
C-B Breakdown Voltage	$V(\text{BR})_{CBO}$	$I_C=(-)1\text{mA}, I_E=0$	(-)60			V
C-E Breakdown Voltage	$V(\text{BR})_{CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	(-)50			V
E-B Breakdown Voltage	$V(\text{BR})_{EBO}$	$I_E=(-)1\text{mA}, I_C=0$	(-)6			V
Turn-on Time	t_{on}	At the test circuit.		0.2		usec
Fall Time	t_f	At the test circuit	(0.1)	0.3		usec
Storage Time	t_{stg}	At the test circuit	(0.7)	0.9		usec

*2SB825, 2SD1061 are classified by 2V 1A h_{FE} as follows :

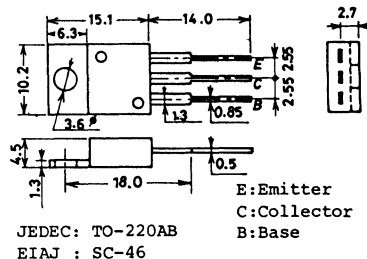
70	Q	140	100	R	200	140	S	280
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Switching Time Test Circuit



(For PNP, polarity is reversed)

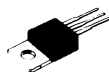
Case Outline 2010A
(unit:mm)



For details, refer to the description of the 2SD1061.

3205MY/O619KI No.687-1/3

2SB826



2010A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1062

High Current Switching Applications

©723E

APPLICATIONS

- Suitable for relay drivers, high-speed inverters, converters, and other general large-current switching

FEATURES

- Low collector-emitter saturation voltage: $V_{CE(sat)} = -0.5V$ (PNP), $0.4V$ (NPN) max.
- Wide ASO and resistant to breakdowns

Values for 2SB826 shown in ()

ABSOLUTE MAXIMUM RATINGS/ $T_a = 25^\circ C$

			unit
Collector to base voltage	V_{CBO}	(-)60	V
Collector to emitter voltage	V_{CEO}	(-)50	V
Emitter to base voltage	V_{EBO}	(-)6	V
Collector current	I_C	(-)12	A
Peak collector current	i_{cp}	(-)15	A
Allowable collector dissipation	P_C	$T_c = 25^\circ C$ 40	W
Junction temperature	T_j	150	$^\circ C$
Storage ambient temperature	T_{stg}	-55~+150	$^\circ C$

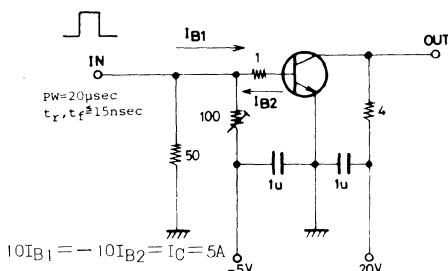
ELECTRICAL CHARACTERISTICS/ $T_a = 25^\circ C$

			min	typ	max	unit
Collector cut-off current	I_{CBO}	$V_{CB} = (-)40V, I_E = 0$			(-)0.1	mA
Emitter cut-off current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$			(-)0.1	mA
DC current gain	$h_{FE}(1)^*$	$V_{CE} = (-)2V, I_C = (-)1A$	70*		280*	
	$h_{FE}(2)$	$V_{CE} = (-)2V, I_C = (-)5A$	30			
Gain bandwidth product	f_T	$V_{CE} = (-)5V, I_C = (-)1A$		10		MHz
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C = (-)6A, I_B = (-)0.3A$			0.4 (-0.5)	V
Collector-base breakdown voltage	$V_{(BR)CBO}$	$I_C = (-)1mA, I_E = 0$	(-)60			V
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-)50			V
Emitter-base breakdown voltage	$V_{(BR)EBO}$	$I_E = (-)1mA, I_C = 0$	(-)6			V
Turn-on time	t_{on}	at the appointed circuit		(0.2)0.1		μs
Fall time	t_f	at the appointed circuit		(0.1)0.05		μs
Storage time	t_{stg}	at the appointed circuit		(0.4)1.2		μs

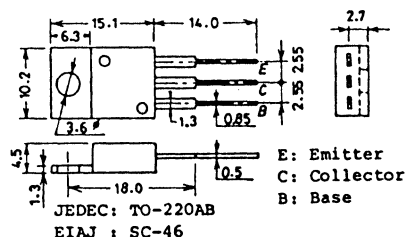
* 2SB826 and 2SD1062 are graded as follows by h_{FE} at 1A:

70	Q	140	100	R	200	140	S	280
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Switching time measurement circuit



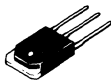
Case outline 2010A
(unit: mm)



For details, refer to the description of the 2SD1062.

3135KI/No.723-1/3

2SB827



2022

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1063

High Current Switching Applications

©688F

Use : Universal high current switching as solenoid driving, high speed inverter and converter.

Features :

- . Low saturation voltage : $V_{CE(sat)} = (-)0.4V$ max.
- . Wide ASO.

() shows the case of 2SB827 only.

Absolute Maximum Ratings at $T_a = 25^\circ C$

Collector to Base Voltage	V_{CBO}	(-)60	V
Collector to Emitter Voltage	V_{CEO}	(-)50	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)7	A
Peak Collector Current	i_{cp}	(-)14	A
Collector Dissipation	P_C	60	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

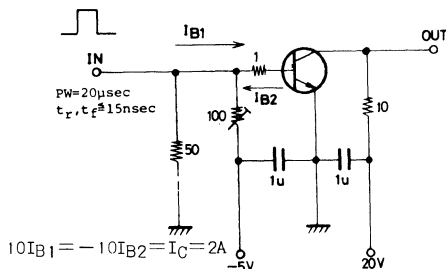
Electrical Characteristics at $T_a = 25^\circ C$

		min	typ	max	unit
Collector Cut off Current	I_{CBO}	$V_{CB} = (-)40V, I_E = 0$	(-)0.1		mA
Emitter Cut off Current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$	(-)0.1		mA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE} = (-)2V, I_C = (-)1A$	70*	280*	
	$h_{FE}(2)$	$V_{CE} = (-)2V, I_C = (-)5A$	30		
Gain Bandwidth Product	f_T	$V_{CE} = (-)5V, I_C = (-)1A$	10		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-)4A, I_B = (-)0.4A$	(-)0.4		V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-)1mA, I_E = 0$	(-)60		V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-)50		V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-)1mA, I_C = 0$	(-)6		V
Turn-on Time	t_{on}	At the test circuit	0.2		usec
Fall Time	t_f	At the test circuit	(0.1)0.3		usec
Storage Time	t_{stg}	At the test circuit	(0.7)0.9		usec

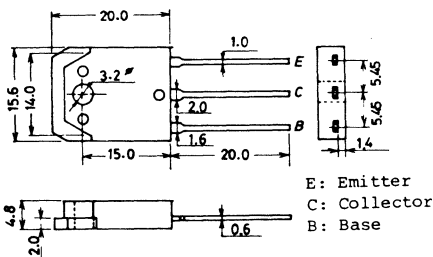
*2SB827, 2SD1063 are classified by 2V 1A h_{FE} as follows :

70	Q	140	100	R	200	140	S	280
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Switching Time Test Circuit



Case Outline 2022 (unit:mm)



For details, refer to the description of the 2SD1063.

2SB828



2022

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1064

High Current Switching Applications

©722E

Use : Universal high current switching as solenoid driving, high speed inverter and converter.

Features :

- . Low saturation voltage : $V_{CE(sat)} = -0.5V$ (PNP), $0.4V$ (NPN) max.
- . Wide ASO.

() shows the case of 2SB828 only.

Absolute Maximum Ratings at $T_a = 25^\circ C$

Collector to Base Voltage	V_{CBO}	(-)60	V
Collector to Emitter Voltage	V_{CEO}	(-)50	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)12	A
Peak Collector Current	i_{cp}	(-)17	A
Collector Dissipation	P_C	$T_C = 25^\circ C$ 80	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

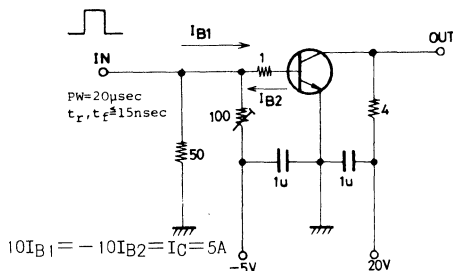
Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cut off Current	I_{CBO}	$V_{CB} = (-) 40V, I_E = 0$			(-)0.1	mA
Emitter Cut off Current	I_{EBO}	$V_{EB} = (-) 4V, I_C = 0$			(-)0.1	mA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE} = (-) 2V, I_C = (-) 1A$	70*		280*	
	$h_{FE}(2)$	$V_{CE} = (-) 2V, I_C = (-) 5A$	30			
Gain Bandwidth Product	f_T	$V_{CE} = (-) 5V, I_C = (-) 1A$		10		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-) 6A, I_B = (-) 0.3A$			0.4 (-0.5)	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-) 1mA, I_E = 0$	(-)60			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-) 1mA, R_{BE} = \infty$	(-)50			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-) 1mA, I_C = 0$	(-)6			V
Turn-on Time	t_{on}	At the test circuit	(0.2)0.1			usec
Fall Time	t_f	At the test circuit	(0.1)0.05			usec
Storage Time	t_{stg}	At the test circuit	(0.4)1.2			usec

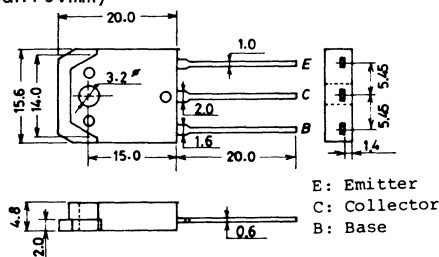
*2SB828, 2SD1064 are classified by $1A h_{FE}$ as follows :

70	Q	140	100	R	200	140	S	280
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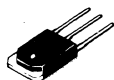
Switching Time test Circuit



Case Outline 2022 (unit:mm)



For details, refer to the description of the 2SD1064.



2022

PNP/NPN Epitaxial Planar Silicon Transistors

2SD1065

High Current Switching Applications

⑧825A

APPLICATIONS

- Suitable for relay drivers, high-speed inverters, converters, and other general large-current switching

FEATURES

- Low collector-emitter saturation voltage: $V_{CE(sat)} = (-)0.5V$ max.
- Wide ASO and resistant to breakdowns

Values for 2SB829 shown in ()

ABSOLUTE MAXIMUM RATINGS/T_a=25°C

ABSOLUTE MAXIMUM RATINGS/T _a =25°C			unit
Collector to base voltage	V _{CBO}	(-)	60 V
Collector to emitter voltage	V _{CEO}	(-)	50 V
Emitter to base voltage	V _{EBO}	(-)	6 V
Collector current	I _C	(-)	15 A
Peak collector current	i _{cp}	(-)	20 A
Allowable collector dissipation	P _C	T _c =25°C	90 W
Junction temperature	T _j		150 °C
Storage ambient temperature	T _{sta}		-55~+150 °C

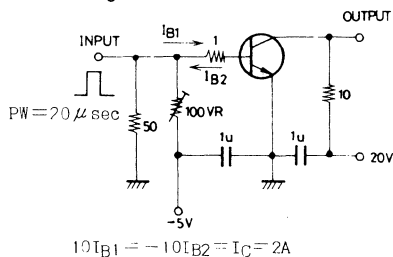
ELECTRICAL CHARACTERISTICS/ $T_a=25^{\circ}\text{C}$

ELECTRICAL CHARACTERISTICS/ $T_a=25^{\circ}\text{C}$			min	typ	max	unit
Collector cut-off current	I_{CBO}	$V_{\text{CB}}=(-)40\text{V}, I_{\text{E}}=0$			0.1	mA
Emitter cut-off current	I_{EBO}	$V_{\text{EB}}=(-)4\text{V}, I_{\text{C}}=0$			0.1	mA
DC current gain	$h_{\text{FE}}(1)^*$	$V_{\text{CE}}=(-)2\text{V}, I_{\text{C}}=(-)1\text{A}$	70*		280*	
	$h_{\text{FE}}(2)$	$V_{\text{CE}}=(-)2\text{V}, I_{\text{C}}=(-)8\text{A}$	30			
Gain bandwidth product	f_{T}	$V_{\text{CE}}=(-)5\text{V}, I_{\text{C}}=(-)1\text{A}$		20		MHz
Collector-emitter breakdown voltage	$V_{\text{CE(sat)}}$	$I_{\text{C}}=(-)8\text{A}, I_{\text{B}}=(-)0.4\text{A}$	(-0.26)	(-0.5)		V
			0.18	0.4		V
Collector-base breakdown voltage	$V_{(\text{BR})\text{CBO}}$	$I_{\text{C}}=(-)1\text{mA}, I_{\text{E}}=0$	(-)60			V
Collector-emitter breakdown voltage	$V_{(\text{BR})\text{CEO}}$	$I_{\text{C}}=(-)1\text{mA}, R_{\text{BE}}=\infty$	(-)50			V
Emitter-base breakdown voltage	$V_{(\text{BR})\text{EBO}}$	$I_{\text{E}}=(-)1\text{mA}, I_{\text{C}}=0$	(-)6			V
Turn-on time	t_{on}	at the appointed circuit		0.2		μs
Storage time	t_{stg}	at the appointed circuit	(0.5)	1.0		μs
Fall time	t_{f}	at the appointed circuit		0.1		μs

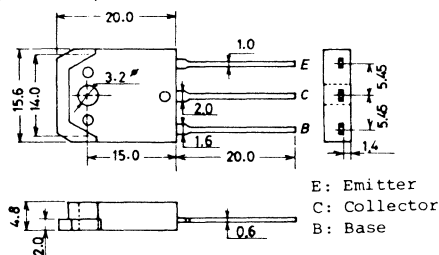
* 2SB829 and 2SD1065 are graded as follows by h_{FE} at 1A:

70	Q	140	100	R	200	140	S	280
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Switching time measurement circuit



Case outline 2022
(unit: mm)



For details, refer to the description of the 2SD1065.

3145KI/No.825-1/3

2SB865



2006A

PNP/NPN Epitaxial Planar
Silicon Darlington Transistors

2SD1153

Driver Applications

©828C

() : 2SB865

Uses

- Relay drivers, hammer drivers, lamp drivers, motor drivers

Features

- High DC current gain (4000 or more)
- Large current capacity and wide ASO
- Low saturation voltage

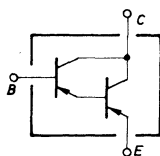
Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-) 80	V
Collector to Emitter Voltage	V_{CEO}	(-) 50	V
Emitter to Base Voltage	V_{EBO}	(-) 10	V
Collector Current	I_C	(-) 1.5	A
Peak Collector Current	i_{cp}	(-) 3	A
Collector Dissipation	P_C	900	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to $+150$	$^\circ\text{C}$

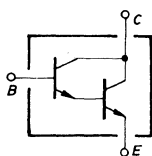
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			(-) 0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)8\text{V}, I_C=0$			(-) 0.1	μA
Common Emitter Current Gain	$h_{FE}(1)$	$V_{CE}=(-)2\text{V}, I_C=(-)500\text{mA}$	4000			
	$h_{FE}(2)$	$V_{CE}=(-)2\text{V}, I_C=(-)10\text{mA}$	3000			
Gain Band-width Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		120		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500\text{mA}, I_B=(-)0.5\text{mA}$		(-) 0.9	(-) 1.5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500\text{mA}, I_B=(-)0.5\text{mA}$		(-) 1.5	(-) 2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-) 80			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	(-) 50			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$	(-) 10			V

Electrical Connection

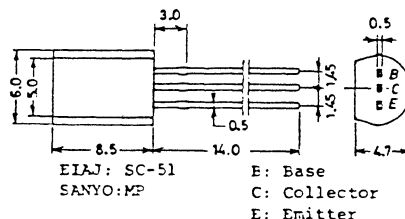


(2SB865)



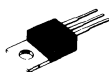
(2SD1153)

Case Outline 2006A (unit:mm)



For details, refer to the description of the 2SD1153.

2SB880



2010A

PNP/NPN Epitaxial Planar
Silicon Darlington Transistors

2SD1190

Driver Applications

©924B

Applications

- Motor drivers, printer hammer drivers, relay drivers, voltage regulators

Features

- High DC current gain
- Large current capacity and wide ASO
- Low saturation voltage

(): 2SB880

Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$

Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$			unit
Collect to Base Voltage	V_{CBO}	(-)70	V
Collector to Emitter Voltage	V_{CEO}	(-)60	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)4	A
Peak Collector Current	i_{cp}	(-)6	A
Collector Dissipation	P_C	1.75	W
	$T_c=25^{\circ}\text{C}$	30	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

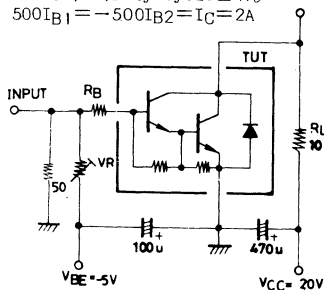
Electrical Characteristics/ $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cut-off Current	I_{CBO}	$V_{CB}=(-)40, I_E=0$			(-)0.1	mA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=(-)5V, I_C=0$			(-)3.0	mA
DC Current Gain	h_{FE}	$V_{CE}=(-)2V, I_C=(-)2A$	2000	5000		
Gain Band-width Product	f_T	$V_{CE}=(-)5V, I_C=(-)2A$		20		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)2A, I_B=(-)4mA$		0.9 (-)1.5		V
				(-1.0)		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)2A, I_B=(-)4mA$			(-)2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5mA, I_E=0$	(-)70			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50mA, R_{BE}=\infty$	(-)60			V
Turn-on Time	t_{on}	At Specified Test Circuit	(0.5)0.6			μs
Storage Time	t_{stg}	"	(1.4)2.7			μs
Fall Time	t_f	"	(1.2)1.6			μs

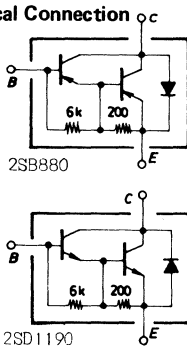
Specified Test Circuit

(For PNP, polarity is reversed.)

$PW=50\mu\text{s}$, Duty Cycle $\leq 1\%$
 $500I_{B1}=-500I_{B2}=I_C=2A$

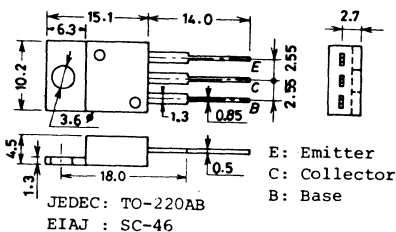


Electrical Connection



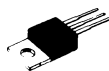
Case Outline 2010A

(unit: mm)



For details, refer to the description of the 2SD1190.

2SB881



2010A

PNP/NPN Epitaxial Planar
Silicon Darlington Transistors

2SD1191

Driver Applications

©925B

Applications

- Motor drivers, printer hammer drivers, relay drivers, voltage regulators

Features

- High DC current gain
- Large current capacity and wide ASO
- Low saturation voltage

() : 2SB881

Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collect to Base Voltage	V_{CBO}	(-) 70	V
Collector to Emitter Voltage	V_{CEO}	(-) 60	V
Emitter to Base Voltage	V_{EBO}	(-) 6	V
Collector Current	I_C	(-) 7	A
Peak Collector Current	i_{cp}	(-) 10	A
Collector Dissipation	P_C	1.75	W
		$T_C=25^\circ\text{C}$	
		-35	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to $+150$	$^\circ\text{C}$

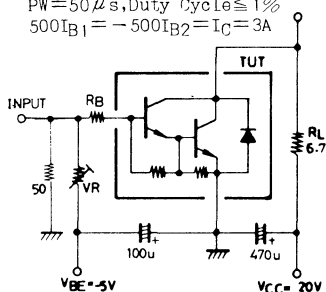
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cut-off Current	I_{CBO}	$V_{CB}=(-)40, I_E=0$			(-) 0.1	mA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=(-)5V, I_C=0$			(-) 3.0	mA
DC Current Gain	h_{FE}	$V_{CE}=(-)2V, I_C=(-)3.5A$	2000	5000		
Gain Band-width Product	f_T	$V_{CE}=(-)5V, I_C=(-)3.5A$		20		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)3.5A, I_B=(-)7mA$		0.9 (-) 1.5 (-) 1.0		V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)3.5A, I_B=(-)7mA$			(-) 2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5mA, I_E=0$	(-) 70			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50mA, R_{BE}=\infty$	(-) 60			V
Turn-on Time	t_{on}	At Specified Test Circuit		(0.5) 0.6		μs
Storage Time	t_{stg}	"		(1.5) 3.0		μs
Fall Time	t_f	"		(1.4) 1.7		μs

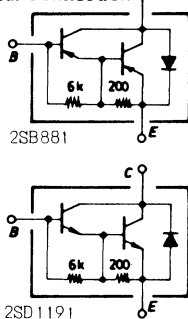
Specified Test Circuit

(For PNP, polarity is reversed.)

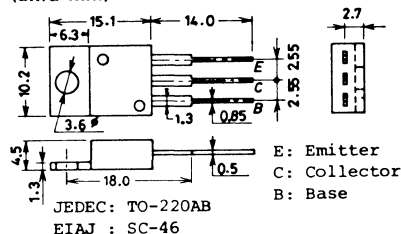
$PW=50\mu\text{s}$, Duty Cycle $\leq 1\%$
 $500I_{B1} = -500I_{B2} = I_C = 3A$



Electrical Connection

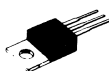


Case Outline 2010A (unit: mm)



For details, refer to the description of the 2SD1191.

2SB882



2010A

PNP/NPN Epitaxial Planar
Silicon Darlington Transistors

2SD1192

Driver Applications

©926A

Applications

- Motor drivers, printer hammer drivers, relay drivers, voltage regulators.

Features

- High DC current gain.
- Large current capacity and wide ASO.
- Low saturation voltage.

(): 2SB882

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)70	V
Collector to Emitter Voltage	V_{CEO}	(-)60	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)10	A
Peak Collector Current	i_{cp}	(-)15	A
Allowable Collector Dissipation	P_C	1.75	W
		40	W
		150	$^\circ\text{C}$
Junction Temperature	T_j		$^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to +150	$^\circ\text{C}$

$T_C=25^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

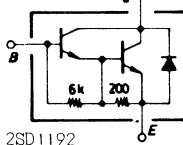
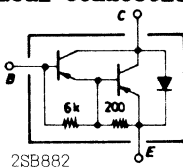
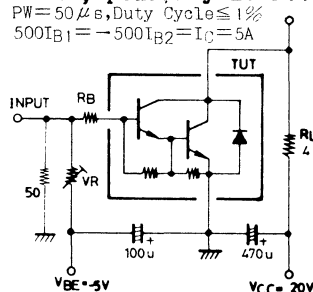
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CE}=(-)40\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$			(-)3.0	mA
DC Current Gain	h_{FE}	$V_{CE}=(-)2\text{V}, I_C=(-)5\text{A}$	2000	5000		
Gain Bandwidth Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)5\text{A}$		20		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{A}, I_B=(-)10\text{mA}$		0.9(-)1.5		V
				(-1.0)		
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)5\text{A}, I_B=(-)10\text{mA}$			(-)2.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)70			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)60			V
Turn-ON Time	t_{on}	At specified Test Circuit	(0.5)	0.6		us
Storage Time	t_{stg}	"	(1.5)	3.0		us
Fall Time	t_f	"	(1.7)	1.8		us

Electrical Connection

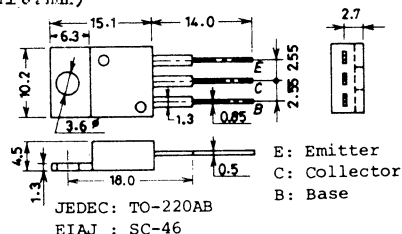
Test Circuit

(For PNP, polarity is reversed.)

$PW=50\mu\text{s}, \text{Duty Cycle}\leq 1\%$
 $500I_{B1}=-500I_{B2}=I_C=5\text{A}$



Case Outline 2010A (unit:mm)



For details, refer to the description of the 2SD1192.

2SB883



2022

PNP/NPN Epitaxial Planar
Silicon Darlington Transistors

2SD1193

Driver Applications

©1036

Uses

- Motor drivers, printer hammer drivers, relay drivers, regulated DC power supply controllers

Features

- High DC current gain
- Large current capacity and wide ASO
- Low saturation voltage

(): 2SB883

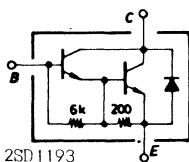
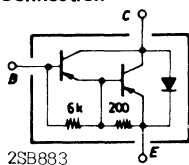
Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)70	V
Collector to Emitter Voltage	V_{CEO}	(-)60	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)15	A
Peak Collector Current	i_{cp}	(-)20	A
Collector Dissipation	P_C	$T_C=25^\circ\text{C}$ 70	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

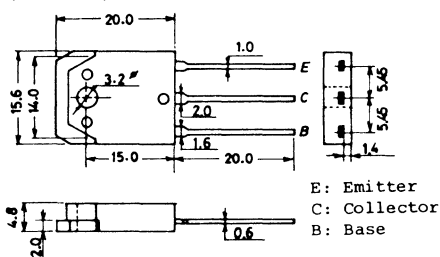
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CE}=(-)40\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$			(-)3	mA
DC Current Gain	h_{FE}	$V_{CE}=(-)2\text{V}, I_C=(-)7\text{A}$	2000	5000		
Gain Band-width Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)7\text{A}$		20		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)7\text{A}, I_B=(-)14\text{mA}$		0.9 (-)1.5		V
				(-)1.0		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)7\text{A}, I_B=(-)14\text{mA}$			(-)2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)70			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)60			V

Electrical Connection

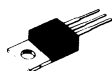


Case Outline 2022 (unit: mm)



For details, refer to the description of the 2SD1193.

2SB884



2010A

PNP/NPN Planar
Silicon Darlington Transistors

2SD1194

Driver Applications

©1018B

Uses

- Motor drivers, printer hammer drivers, relay drivers, regulated DC power supply controllers

Features

- High DC current gain
- Large current capacity and wide ASO
- Low saturation voltage

(): 2SB884

Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$

Absolute Maximum Ratings/T _a =25°C				unit
Collector to Base Voltage	V _{CBO}	(-)	110	V
Collector to Emitter Voltage	V _{CEO}	(-)	100	V
Emitter to Base Voltage	V _{EBO}	(-)	6	V
Collector Current	I _C	(-)	3	A
Peak Collector Current	i _{cp}	(-)	5	A
Collector Dissipation	P _C		1.75	W
		T _c =25°C	30	W
Junction Temperature	T _j		150	°C
Storage Temperature	T _{sta}		-55 to +150	°C

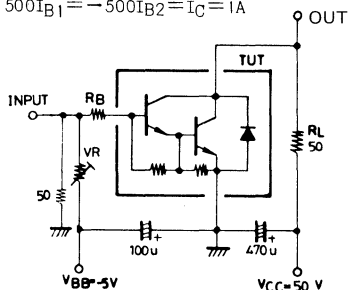
Electrical Characteristics/ $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80\text{V}, I_E=0$			(-)-0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$			(-)-3	mA
Common Emitter DC Current Gain	h_{FE}	$V_{CE}=(-)3\text{V}, I_C=(-)1.5\text{A}$	1500	4000		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)1.5\text{A}, I_B=(-)3\text{mA}$		0.9	(-)-1.5	V
				(-)-1.0		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)1.5\text{A}, I_B=(-)3\text{mA}$			(-)-2.0	V
Gain Band-width Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1.5\text{A}$		20		MHz
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)-110			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)-100			V
Turn-on Time	t_{on}	at Specified Test Circuit	(0.8)	0.7		μs
Storage Time	T_{stg}	"	(2.4)	5.0		μs
Fall Time	t_f	"	(1.2)	1.2		μs

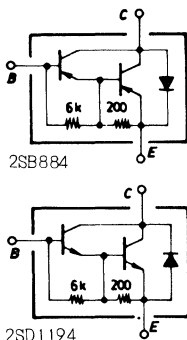
Specified Test Circuit

(For PNP, the polarity is reversed.)

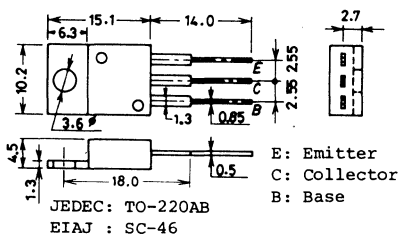
$PW=50\mu\text{s}$, Duty Cycle $\leq 1\%$
 $500I_{B1}=-500I_{B2}=I_C=1\text{A}$



Electrical Connection

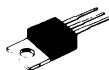


Case Outline 2010A (unit: mm)



For details, refer to the description of the 2SD1194.

2SB885



2010A

PNP/NPN Planar
Silicon Darlington Transistors

2SD1195

Driver Applications

©927B

Uses

- Motor drivers, printer hammer drivers, relay drivers, constant voltage power supply controllers

Features

- High DC current gain
- Large current capacity and wide ASO
- Low saturation voltage

(): 2SB885

Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$

Absolute Maximum Ratings/T _a =25°C				unit
Collector to Base Voltage	V _{CBO}	(-)110		V
Collector to Emitter Voltage	V _{CEO}	(-)100		V
Emitter to Base Voltage	V _{EBO}	(-)6		V
Collector Current	I _C	(-)5		A
Peak Collector Current	i _{cp}	(-)8		A
Collector Dissipation	P _C	1.75		W
		T _C =25°C	35	W
Junction Temperature	T _j	150		°C
Storage Temperature	T _{sta}	-55 to +150		°C

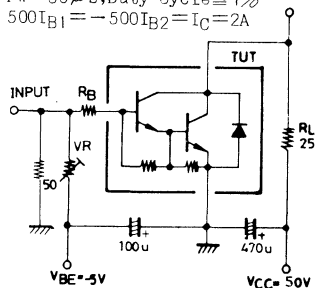
Electrical Characteristics/ $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$			(-)3.0	mA
DC Current Gain	h_{FE}	$V_{CE}=(-)3\text{V}, I_C=(-)2.5\text{A}$	1500	4000		
Gain Band-width Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)2.5\text{A}$		20		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)2.5\text{A}, I_B=(-)5\text{mA}$		0.9 (-)1.5		V
				(-1.0)		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)2.5\text{A}, I_B=(-)5\text{mA}$			(-)2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)110			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)100			V
Turn-on Time	t_{on}	at Specified Test Circuit	(0.7)0.6			μs
Storage Time	t_{stg}	"	(1.3)4.8			μs
Fall Time	t_f	"	(1.5)1.6			μs

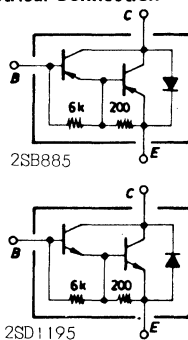
Specified Test Circuit

(For PNP, the polarity is reversed.)

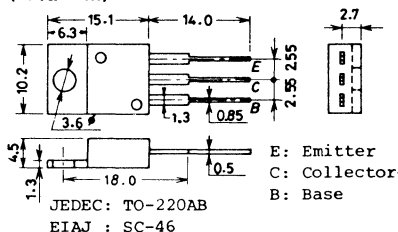
$PW=50\mu\text{s}$, Duty Cycle $\leq 1\%$
 $500I_{B1} = -500I_{B2} = I_C = 2\text{A}$



Electrical Connection

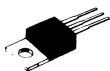


Case Outline 2010A (unit: mm)



For details, refer to the description of the 2SD1195.

2SB886



2010A

PNP/NPN Planar
Silicon Darlington Transistors

2SD1196

Driver Applications

©928

Applications

- . Motor drivers, printer hammer drivers, relay drivers, voltage regulators.

Features

- . High DC current gain.
- . Large current capacity and wide ASO.
- . Low saturation voltage.

(): 2SB886

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)110	V
Collector to Emitter Voltage	V_{CE0}	(-)100	V
Emitter to Base Voltage	V_{EB0}	(-)6	V
Collector Current	I_C	(-)8	A
Peak Collector Current	i_{cp}	(-)12	A
Allowable Collector Dissipation	P_C	1.75	W
		40	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-40 to +150	$^{\circ}\text{C}$

$T_C=25^{\circ}\text{C}$

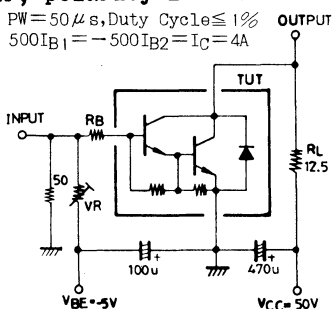
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)80\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)5\text{V}, I_C=0$			(-)3.0	mA
DC Current Gain	h_{FE}	$V_{CE}=(-)3\text{V}, I_C=(-)4\text{A}$	1500	4000		
Gain Bandwidth Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)4\text{A}$		20		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)4\text{A}, I_B=(-)8\text{mA}$		0.9(-)	1.5	V
				(-1.0)		
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)4\text{A}, I_B=(-)8\text{mA}$			(-)2.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)110			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)100			V
Turn-ON Time	t_{on}	At specified Test Circuit	(0.7)	0.6		us
Storage Time	t_{stg}	"	(1.4)	4.8		us
Fall Time	t_f	"	(1.5)	1.6		us

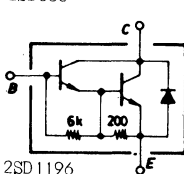
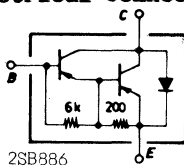
Test Circuit

(For PNP, polarity is reversed.)

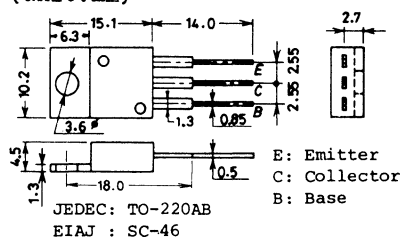
$PW=50\mu\text{s}$, Duty Cycle $\leq 1\%$
 $500I_{B1} = -500I_{B2} = I_C = 4\text{A}$



Electrical Connection



Case Outline 2010A (unit:mm.)



For details, refer to the description of the 2SD1196.

2SB887



2022

PNP/NPN Planar
Silicon Darlington Transistors

2SD1197

Driver Applications

©1079

Uses

- Motor drivers, printer hammer drivers, relay drivers, constant voltage power supply controllers

Features

- High DC current gain
- Large current capacity and wide ASO
- Low saturation voltage

() : 2SB887

Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$

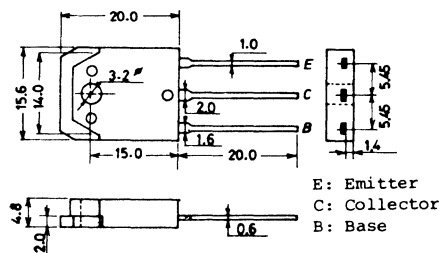
			unit
Collector to Base Voltage	V_{CBO}	(-)110	V
Collector to Emitter Voltage	V_{CEO}	(-)100	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)10	A
Peak Collector Current	i_{cp}	(-)15	A
Collector Dissipation	P_C	$T_C=25^{\circ}\text{C}$ 70	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics/ $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$			(-)3.0	mA
Common Emitter DC Current Gain	h_{FE}	$V_{CE}=(-)3\text{V}, I_C=(-)5\text{A}$	1500	4000		
Gain Band-width Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)5\text{A}$		20		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{A}, I_B=(-)10\text{mA}$		(-1.0)	(-)1.5	V
				0.9		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)5\text{A}, I_B=(-)10\text{mA}$			(-)2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)110			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)100			V

Case Outline 2022

(unit: mm)



2SB888



2003A

PNP/NPN Epitaxial Planar
Silicon Darlington Transistor

Driver Applications

©915B

Applications

- Motor drivers, printer hammer drivers, relay drivers, voltage regulators.

Features

- High DC current gain (5000 or greater).
- Large current capacity and wide ASO.
- Low saturation voltage ($V_{CE(sat)} = -0.8V$ typ).

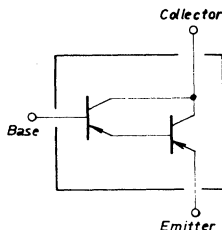
Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	-80	V
Collector to Emitter Voltage	V_{CEO}	-50	V
Emitter to Base Voltage	V_{EBO}	-10	V
Collector Current	I_C	-0.7	A
Peak Collector Current	i_{ep}	-2	A
Allowable Collector Dissipation	P_C	600	mW
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-40 to +150	$^\circ C$

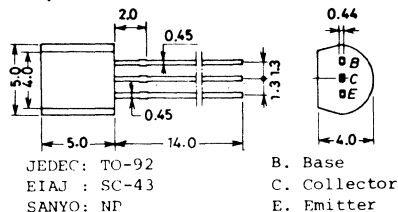
Electrical Characteristics at $T_a = 25^\circ C$

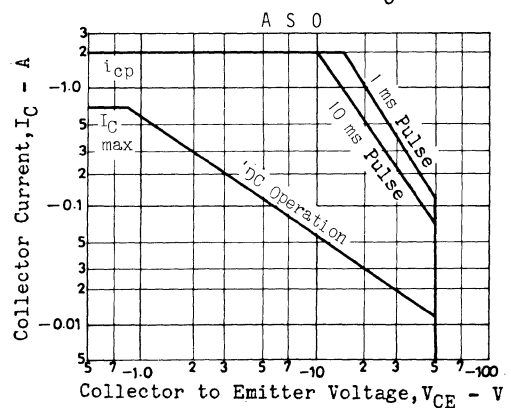
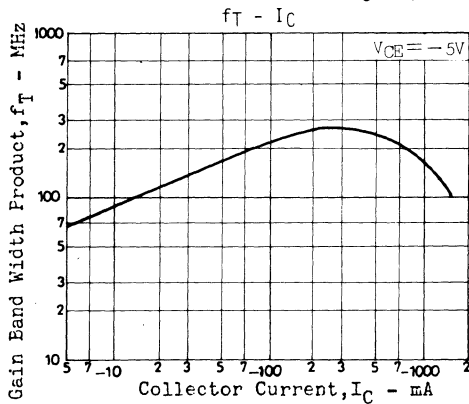
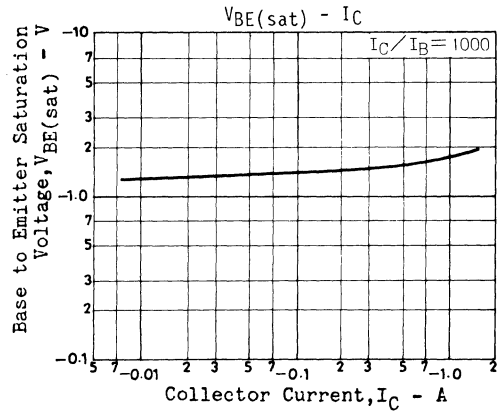
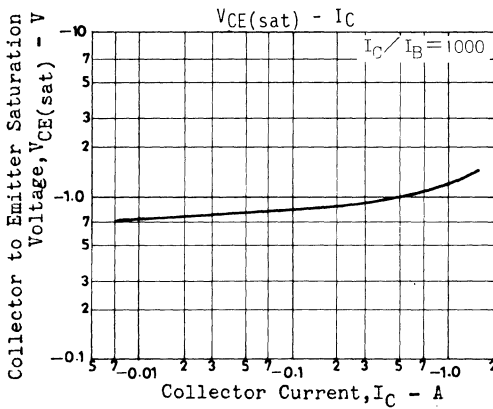
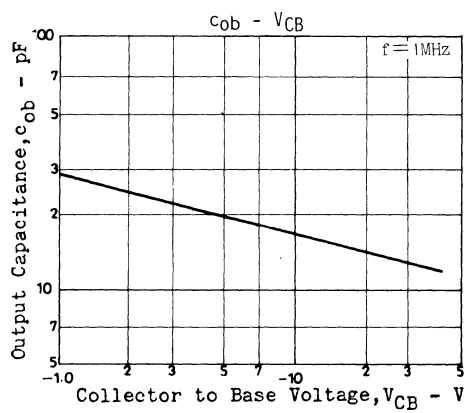
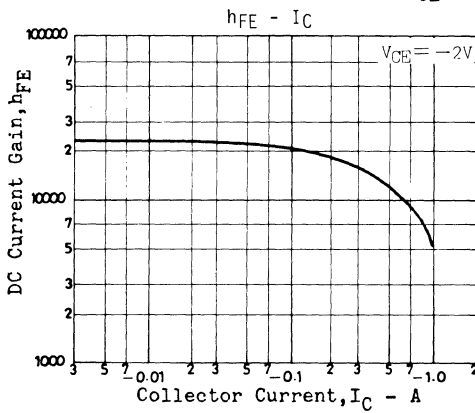
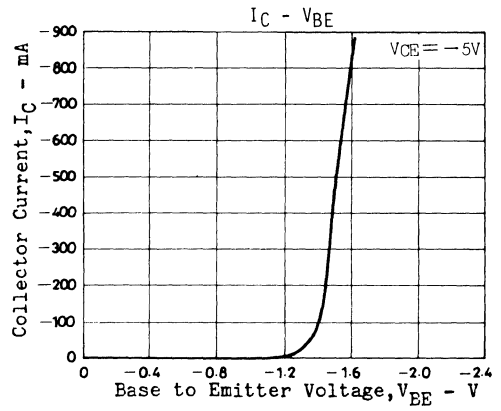
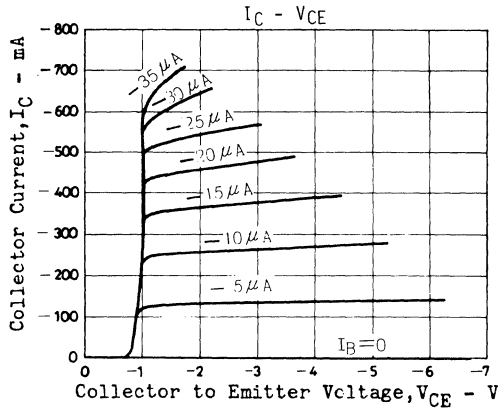
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = -40V, I_E = 0$			-0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = -8V, I_C = 0$			-0.1	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = -2V, I_C = -50mA$	5000			
	$h_{FE}(2)$	$V_{CE} = -2V, I_C = -500mA$	3000			
Gain Bandwidth Product	f_T	$V_{CE} = -5V, I_C = -50mA$		170		MHz
Output Capacitance	c_{ob}	$V_{CB} = -10V, f = 1MHz$		16		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = -100mA, I_B = -0.1mA$	-0.8	-1.2		V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = 100mA, I_B = -0.1mA$	-1.3	-2.0		V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = -10\mu A, I_E = 0$	-80			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = -1mA, R_{BE} = \infty$	-50			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = -10\mu A, I_C = 0$	-10			V

Electrical Connection



Case Outline 2003A (unit:mm)







2006A

PNP/NPN Epitaxial Planar Silicon Transistors

2SD1207

High Current Switching Applications

⑨930B

APPLICATIONS

- Power supplies, relay drivers, lamp drivers, and automotive wiring

FEATURES

- FBET and MBIT processed (Original process of SANYO)
- Low saturation voltage
- Large current capacity and wide ASO

Values for 2SB892 shown in ()

ABSOLUTE MAXIMUM RATINGS/T_a=25°C

ABSOLUTE MAXIMUM RATINGS/T _a =25°C			unit
Collector to base voltage	V _{CBO}	(-)60	V
Collector to emitter voltage	V _{CEO}	(-)50	V
Emitter to base voltage	V _{EBO}	(-)6	V
Collector current	I _C	(-)2	A
Peak collector current	i _{cp}	(-)4	A
Allowable collector dissipation	P _C	1	W
Junction temperature	T _j	150	°C
Storage ambient temperature	T _{sta}	-55~+150	°C

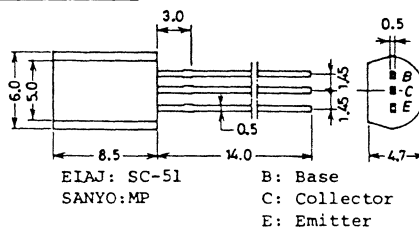
ELECTRICAL CHARACTERISTICS/ $T_a=25^{\circ}\text{C}$

ELECTRICAL CHARACTERISTICS/T _a =25°C			min	typ	max	unit
Collector cut-off current	I _{CBO}	V _{CB} =(-)50V, I _E =0			(-)0.1	μA
Emitter cut-off current	I _{EBO}	V _{EB} =(-)4V, I _C =0			(-)0.1	μA
DC current gain	h _{FE} (1) *	V _{CE} =(-)2V, I _C =(-)100mA	100		560	
	h _{FE} (2)	V _{CE} =(-)2V, I _C =(-)1.5A	40			
Gain bandwidth product	f _T	V _{CE} =(-)10V, I _C =(-)50mA		150		MHz
Output capacitance	c _{ob}	V _{CB} =(-)10V, f=1MHz		12		pF
				(22)		pF
Collector-emitter saturation voltage	V _{CE(sat)}	I _C =(-)1A, I _B =(-)50mA		0.15	0.4	V
				(-0.3)	(-0.7)	V
Base-emitter saturation voltage	V _{BE(sat)}	I _C =(-)1A, I _B =(-)50mA			(-)0.9 (-)1.2	V
Collector-base breakdown voltage	V _{(BR)CBO}	I _C =(-)10μA, I _E =0	(-)60			V
Collector-emitter breakdown voltage	V _{(BR)CEO}	I _C =(-)1mA, R _{BE} =∞	(-)50			V
Emitter-base breakdown voltage	V _{(BR)EBO}	I _E =(-)10μA, I _C =0	(-)6			V

* 2SB892 and 2SD1207 are graded as follows by h_{FE} at 100mA:

100	R	200	140	S	280	200	T	400	280	U	560
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Case outline 2006 A
(unit: mm)



For details, refer to the description of the 2SD1207.

3145KI/No.930-1/3



2003A

PNP Epitaxial Planar Silicon Transistor

High Current Driver Applications

Ⓔ1023B

Applications:

- Power supplies, relay drivers, lamp drivers, strobos

Features:

- Low saturation voltage: $V_{CE(sat)} \leq -0.45V (I_C = -1.5A, I_B = -0.15A)$
- Large current capacity and wide ASO: $I_{Cmax} = -2.5A$

Absolute Maximum Ratings at Ta=25°C

Absolute Maximum Ratings at Ta=25°C			unit
Collector to Base Voltage	VCBO	-20	V
Collector to Emitter Voltage	VCEO	-10	V
Emitter to Base Voltage	VEBO	-7	V
Collector Current	IC	-2.5	A
Peak Collector Current	icp	-5	A
Collector Dissipation	PC	0.75	W
Junction Temperature	Tj	150	°C
Storage Temperature	Tstg	-55 to +150	°C

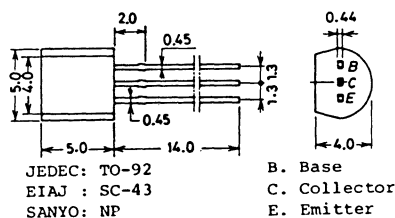
Electrical Characteristics at Ta=25°C

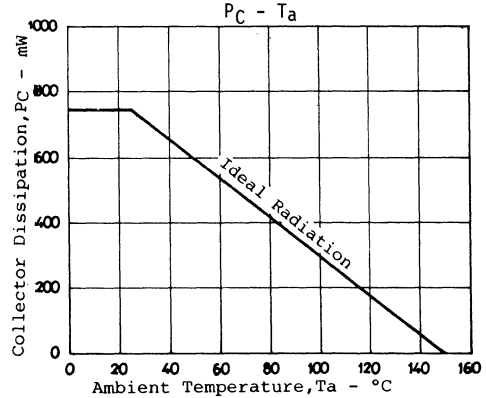
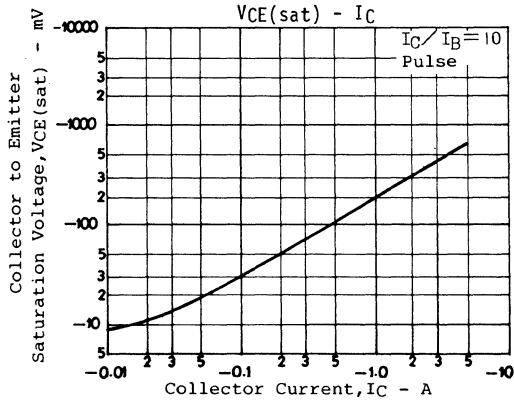
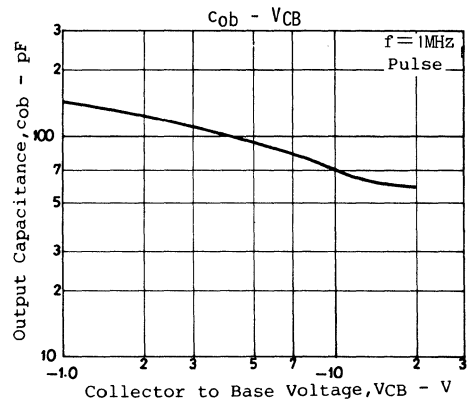
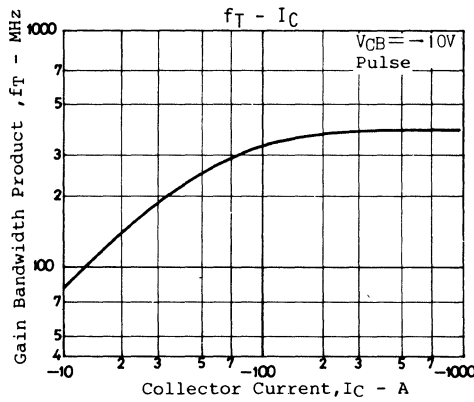
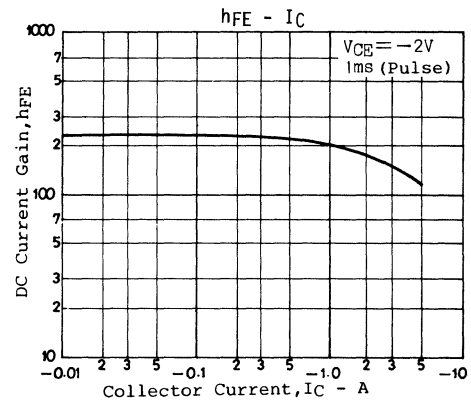
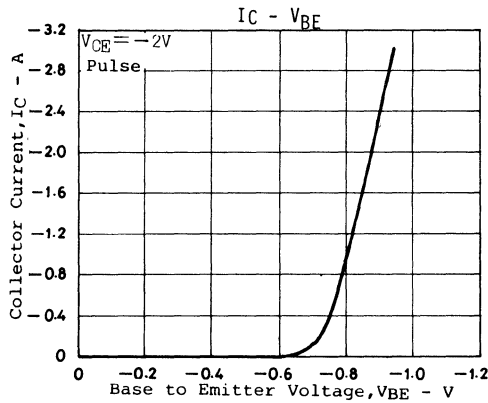
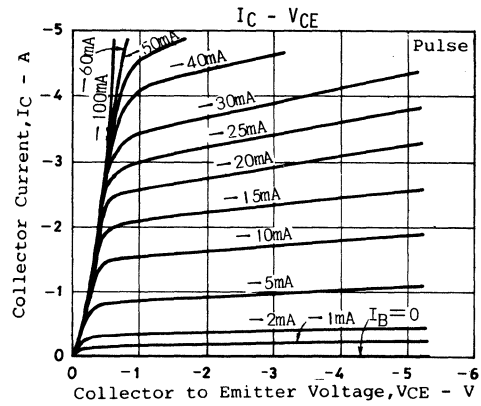
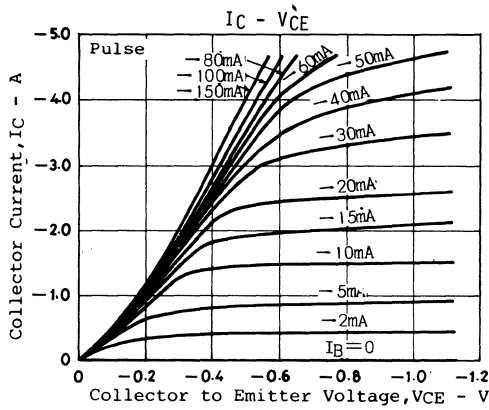
Electrical Characteristics at Ta=25°C			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=-20V, I_E=0$			-1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=-4V, I_C=0$			-1.0	μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=-2V, I_C=-500mA$	100*		560*	
	$h_{FE}(2)$	$V_{CE}=-2V, I_C=-3A, pulse$	70			
Gain Bandwidth Prodcut	f_T	$V_{CE}=-10V, I_C=-50mA$		250		MHz
Output Capacitance	c_{ob}	$V_{CB}=-10V, f=1MHz$		70		pF
C-E Saturation Voltage	$V_{CE}(sat)$	$I_C=-1.5A, I_B=-0.15A$		-0.25-0.45		V
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C=-10\mu A, I_E=0$	-20			V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_C=-1mA, R_{BE}=\infty$	-10			V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E=-10\mu A, I_C=0$	-7			V

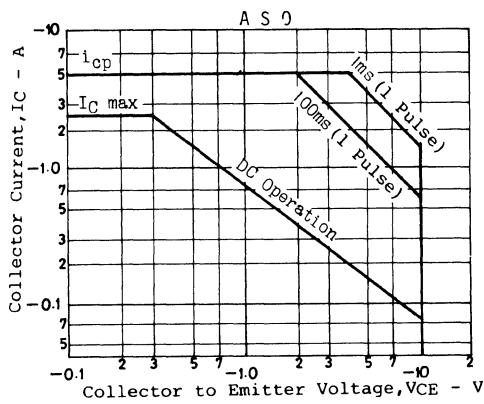
*The 2SB893 is classified by 500mA hFF as follows:

100	E	200	160	F	320	280	G	560
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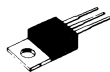
Case Outline 2003A
(unit:mm)







2SB903



2010A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1212

High Current Switching Applications

©990A

APPLICATIONS

- Suitable for relay drivers, high-speed inverters, converters, and other general large-current switching applications

FEATURES

- Low collector-emitter saturation voltage: $V_{CE(sat)} = (-)0.5V$ (PNP), $0.4V$ (NPN) max.
- Large current capacity

Values for 2SB903 shown in ()

ABSOLUTE MAXIMUM RATINGS/ $T_a = 25^\circ C$

ABSOLUTE MAXIMUM RATINGS/T _a =25°C			unit	
Collector to base voltage	V _{CBO}	(-)60	V	
Collector to emitter voltage	V _{CEO}	(-)30	V	
Emitter to base voltage	V _{EBO}	(-)6	V	
Collector current	I _C	(-)12	A	
Peak collector current	i _{cp}	(-)20	A	
Allowable collector dissipation	P _C	1.75	W	
		T _C =25°C	35	W
Junction temperature	T _j	150	°C	
Storage ambient temperature	T _{stg}	-55~+150	°C	

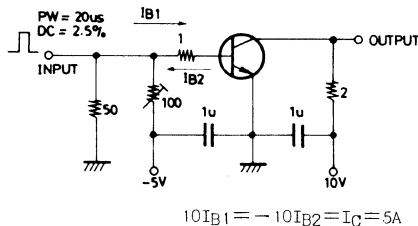
ELECTRICAL CHARACTERISTICS/ $T_a = 25^\circ C$

			min	typ	max	unit
Collector cut-off current	I_{CBO}	$V_{CB} = (-)40V, I_E = 0$			(-)0.1	mA
Emitter cut-off current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$			(-)0.1	mA
DC current gain	$h_{FE(1)}^*$	$V_{CE} = (-)2V, I_C = (-)1A$	70*		280*	
	$h_{FE(2)}$	$V_{CE} = (-)2V, I_C = (-)6A$	30			
Gain bandwidth product	f_T	$V_{CE} = (-)5V, I_C = (-)1A$		120		MHz
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C = (-)5A, I_B = (-)0.25A$			(-0.5)	V
					0.4	V
Collector-base breakdown voltage	$V_{(BR)CBO}$	$I_C = (-)1mA, I_E = 0$	(-)60			V
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-)30			V
Emitter-base breakdown voltage	$V_{(BR)EBO}$	$I_E = (-)1mA, I_C = 0$	(-)6			V
Turn-on time	t_{on}	at the appointed circuit		(0.1)0.2		μs
Storage time	t_{stg}	at the appointed circuit		(0.3)0.5		μs
Fall time	t_f	at the appointed circuit		0.03		μs

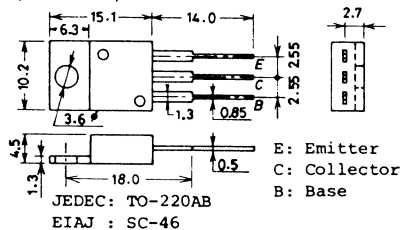
* 2SB903 and 2SD1212 are graded as follows by h_{FE} at 1A:

70	Q	140	100	R	200	140	S	280
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Switching time measurement circuit



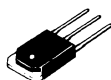
Case outline 2010A (unit: mm)



For details, refer to the description of the 2SD1212.

3075KI/No.990-1/3

2SB904



2022

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1213

High Current Switching Applications

©1022

Use

- Large current switching of relay drivers, high-speed inverters, converters

Features

- Low collector-to-emitter saturation voltage: $V_{CE(sat)} = -0.5V$ (PNP), $0.4V$ (NPN) max.
- Large current capacity

(): 2SB904

Absolute Maximum Ratings/ $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	(-) 60	V
Collector to Emitter Voltage	V_{CEO}	(-) 30	V
Emitter to Base Voltage	V_{EBO}	(-) 6	V
Collector Current	I_C	(-) 20	A
Peak Collector Current	i_{cp}	(-) 30	A
Collector Dissipation	P_C	$T_a = 25^\circ C$ $T_c = 25^\circ C$	2.5 60 W
Junction Temperature	T_j		150 $^\circ C$
Storage Temperature	T_{stg}		-55 to $+150$ $^\circ C$

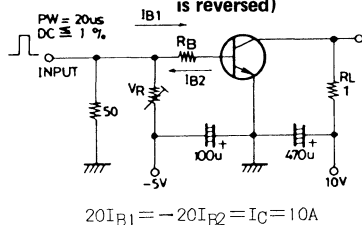
Electrical Characteristics/ $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-)40V, I_E = 0$			(-) 0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$			(-) 0.1	mA
Common emitter DC Current Gain	$h_{FE}(1)$	$V_{CE} = (-)2V, I_C = (-)1A$	70^*		280^*	
	$h_{FE}(2)$	$V_{CE} = (-)2V, I_C = (-)10A$	30			
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = (-)8A, I_B = (-)0.4A$		(-) 0.25	(-) 0.5	V
				0.2	0.4	
Gain Band-width Product	f_T	$V_{CE} = (-)5V, I_C = (-)1A$		120		MHz
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-)1mA, I_E = 0$	(-) 60			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-) 30			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-)1mA, I_C = 0$	(-) 6			V
Turn-on Time	t_{on}	at Specified Test Circuit		300		ns
Storage Time	t_{stg}	"		(300) 600		ns
Fall Time	t_f	"		20		ns

*The 2SB904/2SD1213 are classified as follows according to h_{FE} at $1A$.

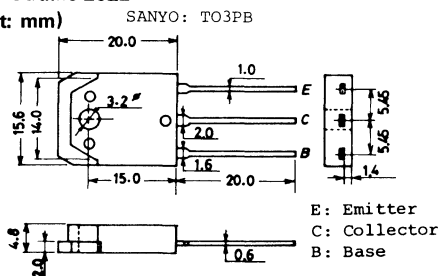
70	Q	140	100	R	200	140	S	280
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Switching Time Test Circuit (For PNP, the polarity is reversed)



Case Outline 2022

(unit: mm)



For details, refer to the description of the 2SD1213.

2SB912



2022

PNP/NPN Epitaxial Planar
Silicon Darlington Transistors

2SD1229

Driver Applications

©1028

Use : Motor drivers, printer hammer drivers, relay drivers, regulated DC power supply controllers.

- Features**
- a. High DC current gain
 - b. Large current capacity and wide ASO
 - c. Low saturation voltage

():2SB912

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

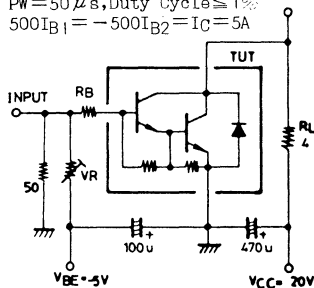
Absolute Maximum Ratings at Ta=25°C			unit	
Collector to Base Voltage	V _{CBO}	(-)70	V	
Collector to Emitter Voltage	V _{CEO}	(-)60	V	
Emitter to Base Voltage	V _{EB0}	(-)6	V	
Collector Current	I _C	(-)10	A	
Peak Collector Current	i _{cp}	(-)15	A	
Collector Dissipation	P _C	2.5	W	
		Tc=25°C	60	W
Junction Temperature	Tj	150	°C	
Storage Temperature	Tstg	-55 to +150	°C	

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

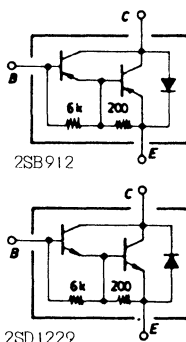
			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)40\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)5\text{V}, I_C=0$			(-)3.0	mA
DC Current Gain	h_{FE}	$V_{CE}=(-)2\text{V}, I_C=(-)5\text{A}$	2000	5000		
Gain Band-width Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)5\text{A}$		20		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{A}, I_B=(-)10\text{mA}$		0.9(-)1.5		V
				(-1.0)		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)5\text{A}, I_B=(-)10\text{mA}$		(-)2.0		V
Collector to Base Breakdown Voltage	$V_{(BR)CB0}$	$I_C=(-)5\text{mA}, I_E=0$	(-)70			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CE0}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)60			V
Turn-on Time	t_{on}	at Specified Test Circuit	(0.5)0.6			us
Storage Time	t_{stg}	"	(1.5)3.0			us
Fall Time	t_f	"	(1.7)1.8			us

Specified Test Circuit
(For PNP, the polarity is reversed.)

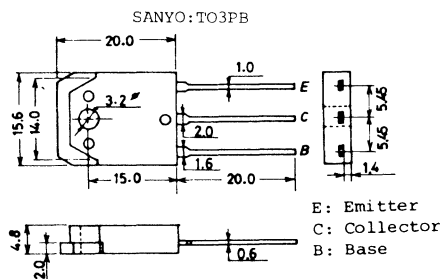
$PW=50\mu\text{s}$, Duty Cycle $\leq 1\%$
 $500I_{B1} = -500I_{B2} = I_C = 5\text{A}$



Equivalent Circuit



Case Outline 2022
(unit:mm)



For details, refer to the description of the 2SD1229.

0193KI, TS No.1028-1/3



2022

PNP/NPN Epitaxial Planar Silicon Darlington Transistors

2SD1230

Driver Applications

Ⓔ1034

Use : Motor drivers, printer hammer drivers, relay drivers, regulated DC power supply controllers.

Features :

- a. High DC current gain
- b. Large current capacity and wide ASO
- c. Low saturation voltage

():2SB913

Absolute Maximum Ratings at Ta=25°C

Absolute Maximum Ratings at Ta=25°C		unit
Collector to Base Voltage	V _{CBO}	(-)110 V
Collector to Emitter Voltage	V _{CEO}	(-)100 V
Emitter to Base Voltage	V _{EB0}	(-)6 V
Collector Current	I _C	(-)8 A
Peak Collector Current	i _{cp}	(-)12 A
Collector Dissipation	P _C	2.5 W
	Tc=25°C	60 W
Junction Temperature	Tj	150 °C
Storage Temperature	Tstg	-55 to +150 °C

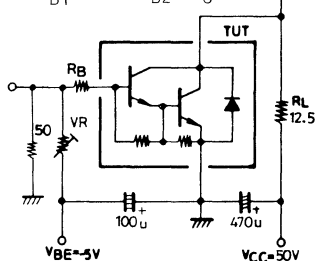
Electrical Characteristics at Ta=25°C

Electrical Characteristics at Ta=25°C			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80V, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5V, I_C=0$			(-)3	mA
DC Current Gain	h_{FE}	$V_{CE}=(-)3V, I_C=(-)4A$	1500	4000		
Gain Band-width Product	f_T	$V_{CE}=(-)5V, I_C=(-)4A$		20		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)4A, I_B=(-)8mA$		0.9(-1.0)	1.5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)4A, I_B=(-)8mA$			(-)2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5mA, I_E=0$	(-)110			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=50mA, R_{BE}=\infty$	(-)100			V
Turn-on Time	t_{on}	at Specified Test Circuit		(0.7)0.6		us
Storage Time	t_{stg}	"		(1.4)4.8		us
Fall Time	t_f	"		(1.5)1.6		us

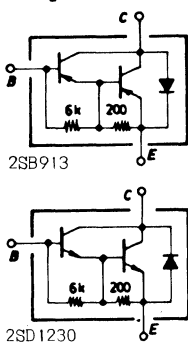
Specified Test Circuit

(For PNP, the polarity is reversed.)

$PW=50\mu s, Duty\ Cycle \leq 1\%$

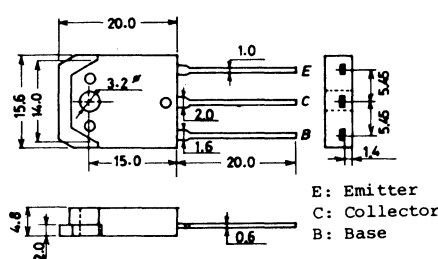
$$50QI_{B1} = -500I_{B2} = I_C = 4A \quad \text{9}$$


Equivalent Circuit



Case Outline 2022
(unit:mm)

SANYO: TO3PB

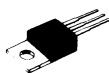


E: Emitter
C: Collector
B: Base

For details, refer to the description of the 2SD1230.

0193KI, TS No. 1034-1/3

2SB919



2010A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1235

High Current Switching Applications

(E)1046

Use

- Large current switching of relay drivers, high-speed inverters, converters

Features

- Low collector-to-emitter saturation voltage: $V_{CE(sat)} = -0.5V$ (PNP), $0.4V$ (NPN) max.
- Large current capacity

(): 2SB919

Absolute Maximum Ratings/ $T_a = 25^\circ C$

Absolute Maximum Ratings/T _a =25°C				unit
Collector to Base Voltage	V _{CBO}	(-)60		V
Collector to Emitter Voltage	V _{CEO}	(-)30		V
Emitter to Base Voltage	V _{EBO}	(-)6		V
Collector Current	I _C	(-)8		A
Peak Collector Current	i _{cp}	(-)15		A
Collector Dissipation	P _C	T _a =25°C	1.75	W
		T _c =25°C	30	W
Junction Temperature	T _j		150	°C
Storage Temperature	T _{sta}		-55 to +150	°C

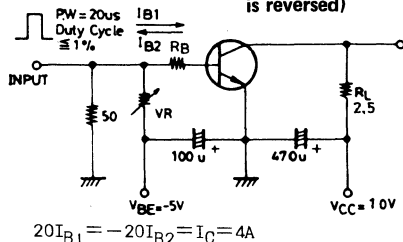
Electrical Characteristics/ $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-)40V, I_E = 0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$			(-)0.1	mA
Common Emitter DC Current Gain	$h_{FE}(1)$	$V_{CE} = (-)2V, I_C = (-)1A$	70*		280*	
	$h_{FE}(2)$	$V_{CE} = (-)2V, I_C = (-)4A$	30			
Gain Band-width Product	f_T	$V_{CE} = (-)5V, I_C = (-)1A$		120		MHz
Collector to Emitter Saturation	$V_{CE(sat)}$	$I_C = (-)3A, I_B = (-)0.15A$			0.4 (-0.5)	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-)1mA, I_E = 0$	(-)60			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-)30			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-)1mA, I_C = 0$	(-)6			V
Turn-on Time	t_{on}	at Specified Test Circuit			0.1	μs
Storage Time	t_{stg}	"			(0.2)0.5	μs
Fall Time	t_f	"			0.03	μs

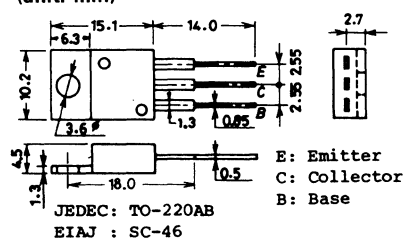
* The 2SB919/2SD1235 are classified as follows according to h_{FE} at 1A.

70	Q	140	100	R	200	140	S	280
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Switching Time Test Circuit (For PNP, the polarity is reversed)

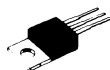


Case Outline 2010A (unit: mm)



For details, refer to the description of the 2SD1235.

2SB920L



2010A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1236L

High Current Switching Applications

©1796

Applications

- . Suitable for relay drivers, high-speed inverters, converters and other general high-current switching applications.

Features

- . Low collector-emitter saturation voltage: $V_{CE(sat)} = (-)0.5V(PNP), 0.4V(NPN)max.$
- . Large current capacity.

(): 2SB920L

Absolute Maximum Ratings at $T_a = 25^\circ C$

Absolute Maximum Ratings at Ta=25°C			unit
Collector to Base Voltage	V _{CBO}	(-)90	V
Collector to Emitter Voltage	V _{CEO}	(-)80	V
Emitter to Base Voltage	V _{EBO}	(-)6	V
Collector Current	I _C	(-)5	A
Peak Collector Current	i _{cp}	(-)9	A
Collector Dissipation	P _C	1.75	W
	Tc=25°C	30	W
Junction Temperature	Tj	150	°C
Storage Temperature	Tstg	-55 to +150	°C

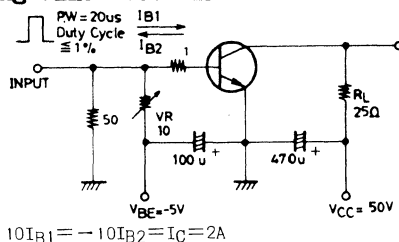
Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-)80V, I_E = 0$		(-)0.1		mA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$		(-)0.1		mA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE} = (-)2V, I_C = (-)1A$	70*		280*	
	$h_{FE}(2)$	$V_{CE} = (-)2V, I_C = (-)3A$	30			
Gain Bandwidth Product	f_T	$V_{CE} = (-)5V, I_C = (-)1A$		20		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-)3A, I_B = (-)0.3A$			0.4 (-0.5)	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-)1mA, I_E = 0$	(-)90			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-)80			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-)1mA, I_C = 0$	(-)6			V
Turn-ON Time	t_{on}	At specified Test Circuit	(0.2)0.1			us
Storage Time	t_{stg}	"	(0.7)1.2			us
Fall Time	t_f	"	(0.2)0.4			us

* The 2SB920L/2SD1236L are graded as follows by h_{FE} at 1A.

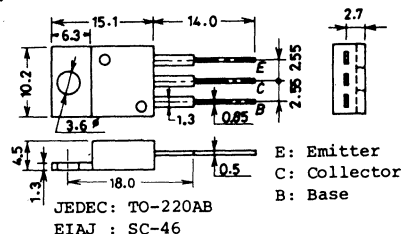
70	Q	140	100	R	200	140	S	280
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Switching Time Test Circuit



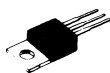
Case Outline 2010A

(unit:mm)



For details, refer to the description of the 2SD1236L.

2SB921L



2010A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1237L

High Current Switching Applications

©1797

APPLICATIONS

- Suitable for relay drivers, high-speed inverters, converters, and other general large-current switching applications

FEATURES

- Low collector-emitter saturation voltage: $V_{CE(sat)} = -0.5V(\text{PNP}), 0.4V(\text{NPN})$ max.
- Large current capacity

Values for 2SB921L shown in ()

ABSOLUTE MAXIMUM RATINGS/ $T_a=25^\circ\text{C}$

ABSOLUTE MAXIMUM RATINGS/T _a =25°C			unit	
Collector to base voltage	V _{CBO}	(-)90	V	
Collector to emitter voltage	V _{CEO}	(-)80	V	
Emitter to base voltage	V _{EBO}	(-)6	V	
Collector current	I _C	(-)7	A	
Peak collector current	i _{cp}	(-)12	A	
Allowable collector dissipation	P _C	1.75	W	
		T _c =25°C	40	W
Junction temperature	T _j	150	°C	
Storage ambient temperature	T _{sta}	-55~+150	°C	

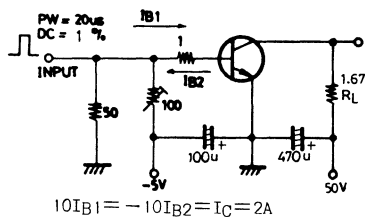
ELECTRICAL CHARACTERISTICS/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector cut-off current	I_{CBO}	$V_{CB}=(-)80V, I_E=0$			(-)0.1	mA
Emitter cut-off current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$			(-)0.1	mA
DC current gain	$h_{FE}(1)^*$	$V_{CE}=(-)2V, I_C=(-)1A$	70*		280*	
	$h_{FE}(2)$	$V_{CE}=(-)2V, I_C=(-)4A$	30			
Gain bandwidth product	f_T	$V_{CE}=(-)5V, I_C=(-)1A$		20		MHz
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C=(-)4A, I_B=(-)0.4A$			0.4	V
					(-0.5)	V
Collector-base breakdown voltage	$V_{(BR)CBO}$	$I_C=(-)1mA, I_E=0$	(-)90			V
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	(-)80			V
Emitter-base breakdown voltage	$V_{(BR)EBO}$	$I_E=(-)1mA, I_C=0$	(-)6			V
Turn-on time	t_{on}	at the appointed circuit		(0.2)0.1		μs
Storage time	t_{stg}	at the appointed circuit		(0.7)1.6		μs
Fall time	t_f	at the appointed circuit		(0.2)0.4		μs

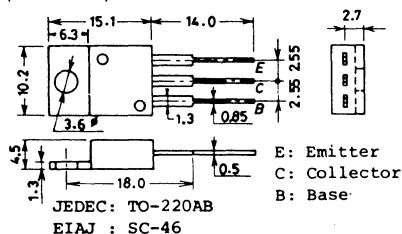
* 2SB921L and 2SD1237L are graded as follows by h_{FE} at 1A:

70	Q	140	100	R	200	140	S	280
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Switching time measurement circuit



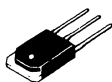
Case outline 2010A
(unit: mm)



For details, refer to the description of the 2SD1237L.

N2275MY/E991/No.1797-1/3

2SB922L



2022

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1238L

High Current Switching Applications

©1798

Use

Suitable for relay drivers, high-speed inverters, converters, and other large-current switching applications.

Features

- Low collector-to-emitter saturation voltage: $V_{CE(sat)} = -0.5V$ (PNP), $0.4V$ (NPN) max.
 - Wide ASO and highly resistant to breakdown
- (): 2SB922L

Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	(-) 90	V
Collector to Emitter Voltage	V_{CEO}	(-) 80	V
Emitter to Base Voltage	V_{EBO}	(-) 6	V
Collector Current	I_C	(-) 12	A
Peak Collector Current	i_{cp}	(-) 20	A
Collector Dissipation	P_C	80	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

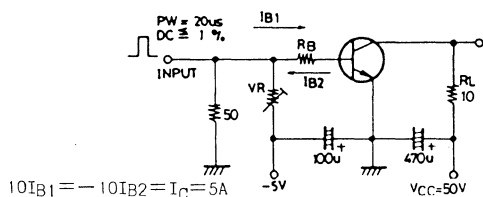
Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-) 80V, I_E = 0$			(-) 0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-) 4V, I_C = 0$			(-) 0.1	mA
DC Current gain	$h_{FE}(1)$	$V_{CE} = (-) 2V, I_C = (-) 1A$	70*		280*	
	$h_{FE}(2)$	$V_{CE} = (-) 2V, I_C = (-) 6A$	30			
Gain Bandwidth Product	f_T	$V_{CE} = (-) 5V, I_C = (-) 1A$		20		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-) 6A, I_B = (-) 0.6A$			0.4 (-0.5)	V
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C = (-) 1mA, I_E = 0$	(-) 90			V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_C = (-) 1mA, R_{BE} = \infty$	(-) 80			V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E = (-) 1mA, I_C = 0$	(-) 6			V
Turn-on Time	t_{on}	at test circuit		0.2		us
Storage Time	t_{stg}	"		1.7 (0.7)		us
Fall Time	t_f	"		0.2 (0.1)		us

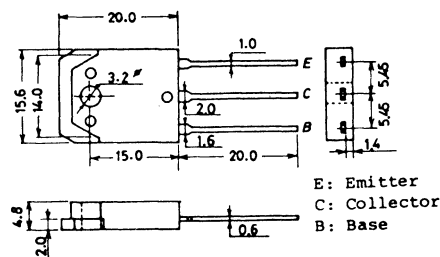
*: The 2SB922L/2SD1238L are classified by 1A h_{FE} as follows:

70	Q	140	100	R	200	140	S	280
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Switching Time Test Circuit



Case Outline 2022 (unit:mm)



For details, refer to the description of the 2SD1238L.

2SB926



2003A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1246

High Current Switching Applications

©1030D

Applications

- Power supplies, relay drivers, car applications

Features

- Adoption of FBET, MBIT process
- Low saturation voltage
- Large current capacity and wide ASO

() : 2SB926

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Collector to base voltage	V_{CBO}	(-) 30	V
Collector to emitter voltage	V_{CEO}	(-) 25	V
Emitter to base voltage	V_{EBO}	(-) 6	V
Collector current	I_C	(-) 2	A
Peak collector current	i_{cp}	(-) 5	A
Collector dissipation	P_C	0.75	W
Junction temperature	T_j	150	$^\circ\text{C}$
Storage temperature	T_{stg}	$-55 \sim +150$	$^\circ\text{C}$

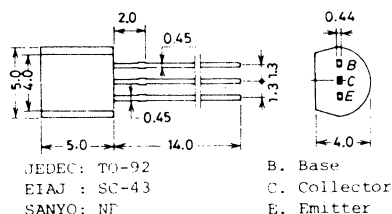
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = (-)20\text{ V}, I_E = 0$			(-) 0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = (-)4\text{ V}, I_C = 0$			(-) 0.1	μA
DC current gain	$h_{FE}(1)$	$V_{CE} = (-)2\text{ V}, I_C = (-)100\text{ mA}$	100^*		560^*	
	$h_{FE}(2)$	$V_{CE} = (-)2\text{ V}, I_C = (-)1.5\text{ A, pulse}$	65	130		
Gain bandwidth product	f_T	$V_{CE} = (-)10\text{ V}, I_C = (-)50\text{ mA}$		150		MHz
Common base output capacitance	c_{ob}	$V_{CB} = (-)10\text{ V}, f = 1\text{ MHz}$		19		pF
				(32)		
Collector to emitter saturation voltage	$V_{CE(sat)}$	$I_C = (-)1.5\text{ A}, I_B = (-)75\text{ mA, pulse}$		0.18	0.4	V
				(-) 0.35	(-) 0.6	
Base to emitter saturation voltage	$V_{BE(sat)}$	$I_C = (-)1.5\text{ A}, I_B = (-)75\text{ mA}$		(-) 0.85	(-) 1.2	V
Collector to base breakdown voltage	$V_{(BR)CBO}$	$I_C = (-)10\text{ }\mu\text{A}, I_E = 0$		(-) 30		V
Collector to emitter breakdown voltage	$V_{(BR)CEO}$	$I_C = (-)1\text{ mA}, R_{BE} = \infty$		(-) 25		V
Emitter to base breakdown voltage	$V_{(BR)EBO}$	$I_E = (-)10\text{ }\mu\text{A}, I_C = 0$		(-) 6		V

* The 2SB926/2SD1246 are classified by 100 mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400	280	U	560
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Case Outline 2003A (unit:mm)



For details, refer to the description of the 2SD1246.

2SB927



2006A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1247

High Current Switching Applications

©1029B

Applications

- Power supplies, relay drivers, lamp drivers, car applications

Features

- Adoption of FBET, MBIT process
- Low saturation voltage
- Large current capacity and wide ASO

() : 2SB927

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-) 30	V
Collector to Emitter Voltage	V_{CE0}	(-) 25	V
Emitter to Base Voltage	V_{EB0}	(-) 6	V
Collector Current	I_C	(-) 2.5	A
Peak Collector Current	i_{cp}	(-) 5	A
Collector Dissipation	P_C	1.0	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

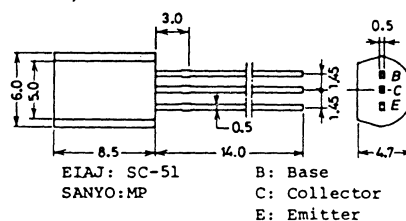
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)20\text{V}, I_E=0$			(-) 0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-) 0.1	μA
DC Current Gain	$h_{FE(1)}$	$V_{CE}=(-)2\text{V}, I_C=(-)0.1\text{A}$	100*		560*	
	$h_{FE(2)}$	$V_{CE}=(-)2\text{V}, I_C=(-)1.5\text{A}$	65	130		
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		150		MHz
Common Base Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		19		pF
				(32)		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)1.5\text{A}, I_B=(-)75\text{mA}$		0.18	0.4	V
				(-0.35)(-0.6)		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)1.5\text{A}, I_B=(-)75\text{mA}$		0.85	1.2	V

* The 2SB927/2SD1247 are classified by 0.1A h_{FE} as follows :

100	R	200	140	S	280	200	T	400	280	U	560
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Case Outline 2006A (unit:mm)



For details, refer to the description of the 2SD1247.

2SB985



2006A

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1347

High Current Driver Applications

©1244B

Applications

- Power Supplies, relay drivers, lamp drivers, car applications

Features

- Adoption of FBET, MBIT process
- Low saturation voltage
- Large current capacity and wide ASO

() : 2SB985

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-) 60	V
Collector to Emitter Voltage	V_{CEO}	(-) 50	V
Emitter to Base Voltage	V_{EBO}	(-) 6	V
Collector Current	I_C	(-) 3	A
Peak Collector Current	i_{cp}	(-) 6	A
Collector Dissipation	P_C	1	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

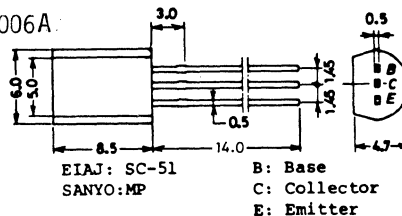
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	V_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$		(-) 1.0		μA
Emitter Cutoff Current	V_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$		(-) 1.0		μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=(-)2\text{V}, I_C=(-)100\text{mA}$	100*		560*	
	$h_{FE}(2)$	$V_{CE}=(-)2\text{V}, I_C=(-)3\text{A}$	40			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		150		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		25		pF
				(39)		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)2\text{A}, I_B=(-)100\text{mA}$	0.19	0.5		V
		Pulse		(-0.35)(-0.7)		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)2\text{A}, I_B=(-)100\text{mA}$	(-) 0.94	(-) 1.2		V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-) 60			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	(-) 50			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$	(-) 6			V

*The 2SB985/2SD1347 are classified by 100mA h_{FE} as follows :

100	R	200	140	S	280	200	T	400	280	U	560
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Case Outline 2006A
(unit:mm)



For details, refer to the description of the 2SD1347.

2SB986



2009

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1348

High Current Driver Applications

©1245A

Use

- . Power supply, relay driver, lamp driver, electrical equipment.

Features

- . Adoption of FBET, MBIT process.
- . Low saturation voltage.
- . Large current capacity and wide ASO.

():2SB986

Absolute Maximum Ratings at Ta=25°C

Absolute Maximum Ratings at Ta=25°C			unit	
Collector to Base Voltage	V _{CB0}	(-)60	V	
Collector to Emitter Voltage	V _{CEO}	(-)50	V	
Emitter to Base Voltage	V _{EB0}	(-)6	V	
Collector Current	I _C	(-)4	A	
Peak Collector Current	i _{cp}	(-)6	A	
Collector Dissipation	P _C	1.2	W	
		Tc=25°C	10	W
Junction Temperature	Tj	150	°C	
Storage Temperature	Tstg	-55 to +150	°C	

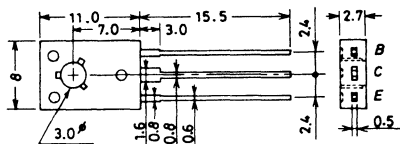
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)40V, I_E=0$			(-)1.0	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)4V, I_C=0$			(-)1.0	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=(-)2V, I_C=(-)100mA$	100*		560*	
	$h_{FE}(2)$	$V_{CE}=(-)2V, I_C=(-)3A$	40			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		150		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10V$		25		pF
				(39)		

* The 2SB986/2SD1348 are classified by 100mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400	280	U	560
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Case Outline 2009 (unit:mm)

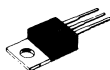


JEDEC: TO-126

B: Base
C: Collector
E: Emitter

For details, refer to the description of the 2SD1348.

2SB1037



2010A

PNP/NPN Planar
Silicon Transistors

2SD1459

Color TV Vertical Output, Sound Output Applications

©1256

Features

- High allowable collector dissipation ($P_C = 2W$)
- WIDE ASO

() : 2SB1037

Absolute Maximum Ratings/ $T_a = 25^\circ C$

			unit
Collector to base voltage	V_{CBO}	(-)150	V
Collector to emitter voltage	V_{CEO}	(-)150	V
Emitter to base voltage	V_{EBO}	(-)5	V
Collector current	I_C	(-)1.5	A
Peak collector current	i_{cp}	(-)3	A
Collector dissipation	P_C	2.0	W
		30	W
Junction temperature	T_j	175	$^\circ C$
Storage temperature	T_{stg}	-55 ~ +175	$^\circ C$

$T_C = 25^\circ C$

Electrical Characteristics/ $T_a = 25^\circ C$

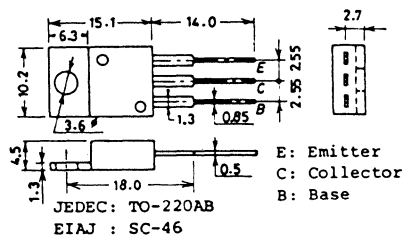
			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = (-)120 V$			(-)10	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = (-)5 V$			(-)10	μA
DC current gain	h_{FE}	$V_{CE} = (-)5 V, I_C = (-)0.3 A$	70*		200*	
Gain bandwidth product	f_T	$V_{CE} = (-)5 V, I_C = (-)100 mA$		(15)8		MHz
C-E saturation voltage	$V_{CE(sat)}$	$I_C = (-)500 mA, I_B = (-)50 mA$			(-)1.5	V
B-E saturation voltage	$V_{BE(sat)}$	$I_C = (-)500 mA, I_B = (-)50 mA$			(-)1.2	V

* The 2SB1037/2SD1459 are classified by 0.3A h_{FE} as follows:

70	Q	140	100	R	200
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Case Outline 2010A

(unit: mm)



For details, refer to the description of the 2SD1459.

2SB1118



2038

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1618

**Low Voltage, High Current Amp,
Muting Applications**

©1784

Features

- . Low collector-to-emitter saturation voltage.
- . Very small size making it easy to provide high-density, small-sized hybrid IC's

(): 2SB1118

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)20	V
Collector to Emitter Voltage	V_{CE0}	(-)15	V
Emitter to Base Voltage	V_{E0}	(-)5	V
Collector Current	I_C	(-)0.7	A
Peak Collector Current	i_{cp}	(-)1.5	A
Collector Dissipation	P_C	500	mW
	P_C Mounted on ceramic board (250mm ² x 0.8mm)	1.3	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)15\text{V}, I_C=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)2\text{V}, I_C=(-)50\text{mA}$	140		800	
	$h_{FE}(2)$	$V_{CE}=(-)2\text{V}, I_C=(-)500\text{mA}$	60			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		250		MHz
C-E Saturation Voltage	$V_{CE(sat)}^1$	$I_C=(-)5\text{mA}, I_B=(-)0.5\text{mA}$		10	25	mV
				(-15)	(-35)	mV
	$V_{CE(sat)}^2$	$I_C=(-)100\text{mA}, I_B=(-)10\text{mA}$		30	80	mV
				(-60)	(-120)	mV
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)100\text{mA}, I_B=(-)10\text{mA}$		(-)0.8	(-)1.2	V
C-B Breakdown Voltage	$V_{(BR)CB0}$	$I_C=(-)10\mu\text{A}$		(-)20		V
C-E Breakdown Voltage	$V_{(BR)CE0}$	$I_C=(-)1\text{mA}$		(-)15		V
E-B Breakdown Voltage	$V_{(BR)E0}$	$I_E=(-)10\mu\text{A}$		(-)5		V
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		8		pF
				(13)		pF

* The 2SB1118/2SD1618 are classified by 50mA h_{FE} as follows:

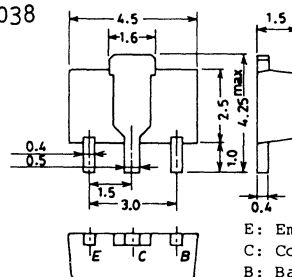
140	S	280	200	E	400	280	U	560
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Case Outline 2038 (unit:mm)

Marking

2SB1118.....BA

2SD1618.....DA



E: Emitter
C: Collector
B: Base

SANYO: PCP

For details, refer to the description of the 2SD1618.

2SB1119



2038

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1619

Low Frequency Amp, Electronic Governor Applications

©1785

Features

- . Very small size making it easy to provide high-density, small-sized hybrid IC's

(): 2SB1119

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)25	V
Collector to Emitter Voltage	V_{CE0}	(-)25	V
Emitter to Base Voltage	V_{EB0}	(-)5	V
Collector Current	I_C	(-)1	A
Peak Collector Current	i_{cp}	(-)2	A
Collector Dissipation	P_C	500	mW
	P_C Mounted on ceramic board (250mm ² x 0.8mm)	1.3	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

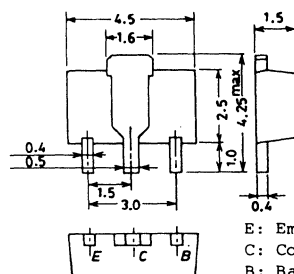
			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CE}=(-)20\text{V}, I_E=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)2\text{V}, I_C=(-)50\text{mA}$	100		560	
	$h_{FE}(2)$	$V_{CE}=(-)2\text{V}, I_C=(-)1\text{A}$	40			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		180		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500\text{mA}, I_E=(-)50\text{mA}$		0.1	0.3	V
				(-0.15)	(-0.7)	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500\text{mA}, I_E=(-)50\text{mA}$		(-)0.85	(-)1.2	V
C-B Breakdown Voltage	$V_{(BR)CB0}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)25			V
C-E Breakdown Voltage	$V_{(BR)CE0}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	(-)25			V
E-B Breakdown Voltage	$V_{(BR)EB0}$	$I_E=(-)10\mu\text{A}, I_C=0$	(-)5			V
Output Capacitance	c_{ob}	$V_{CE}=(-)10\text{V}, f=1\text{MHz}$		15		pF
				(25)		pF

* The 2SB1119/2SD1619 are classified by 50mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400	280	U	560
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Case Outline 2038

(unit:mm)



Marking

2SB1119.....BB

2SD1619.....DB

E: Emitter
C: Collector
B: Base

SANYO: PCP

For details, refer to the description of the 2SD1619.

2065MY, TS No.1785-1/3



High Current Driver Applications

©1786

Applications

- Strobes, voltage regulators, relay drivers, lamp drivers.

Features

- Low collector-to-emitter saturation voltage ($V_{CE(sat)max} = -0.45V$)
- Large current capacity ($I_C = -2.5A$, $i_{cp} = -5A$)
- Very small size making it easy to provide high-density, small-sized hybrid IC's

Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	-20	V
Collector to Emitter Voltage	V_{CEO}	-10	V
Emitter to Base Voltage	V_{EBO}	-7	V
Collector Current	I_C	-2.5	A
Peak Collector Current	i_{cp}	-5	A
Collector Dissipation	P_C	500	mW
	P_C Mounted on ceramic board (250mm ² x 0.8mm)	1.3	W
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

Electrical Characteristics at $T_a = 25^\circ C$

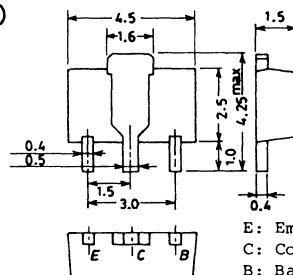
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = -16V, I_E = 0$			-100	nA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = -4V, I_C = 0$			-100	nA
DC Current Gain	$h_{FE(1)}$	$V_{CE} = -2V, I_C = -500mA$	100		560	
	$h_{FE(2)}$	$V_{CE} = -2V, I_C = -3A$	70			
Gain Bandwidth Product	f_T	$V_{CE} = -10V, I_C = -50mA$		250		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = -1.5A, I_E = -0.15A$		-0.25	-0.45	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = -10\mu A, I_E = 0$	-20			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = -1mA, R_{BE} = \infty$	-10			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = -10\mu A, I_C = 0$	-7			V
Output Capacitance	c_{ob}	$V_{CB} = -10V, f = 1MHz$		70		pF

* The 2SB1120 is classified by 500mA h_{FE} as follows:

100	E	200	160	F	320	280	G	560
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Case Outline 2038

(unit:mm)

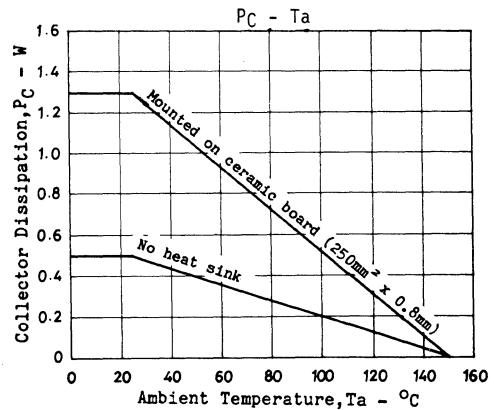
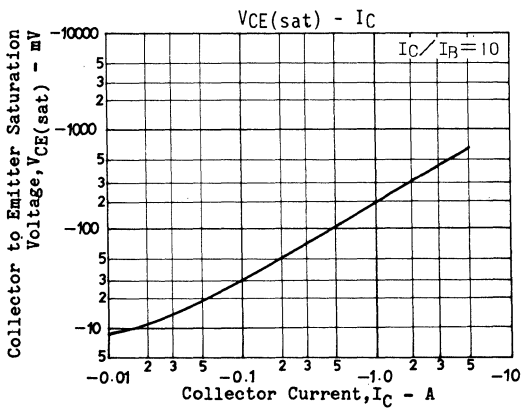
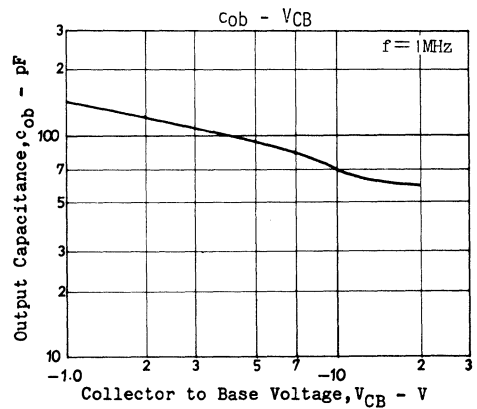
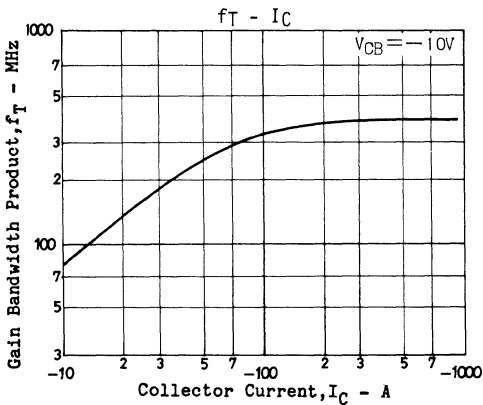
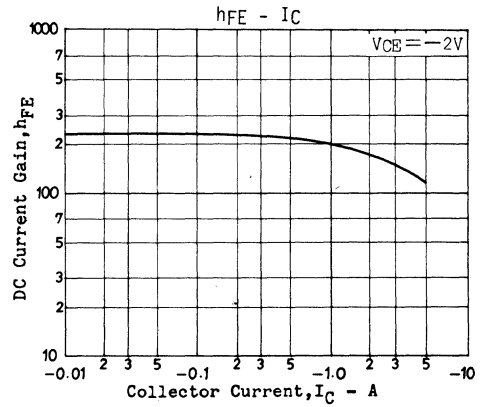
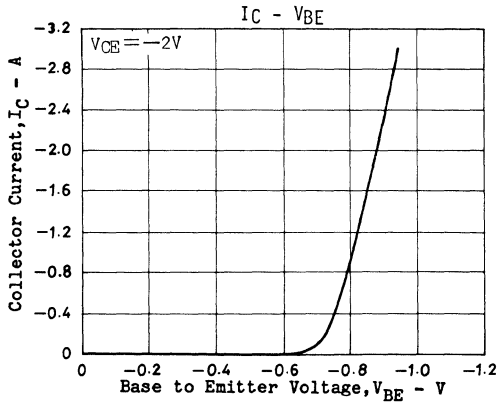
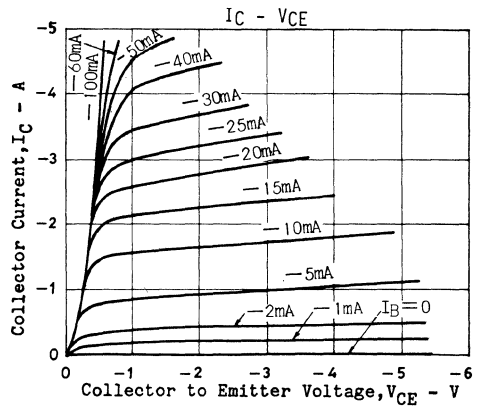
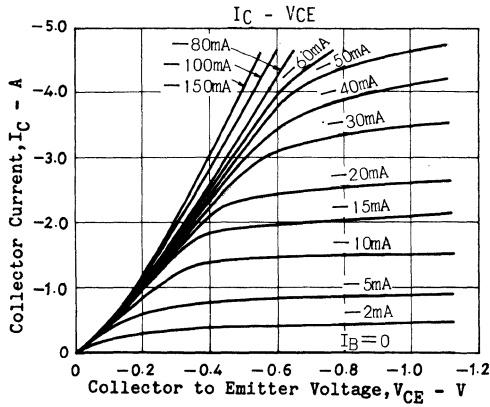


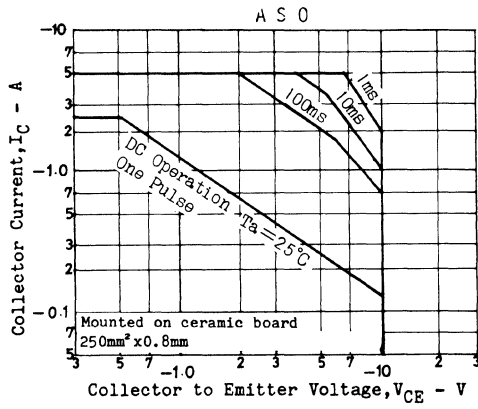
Marking

2SB1120.....BC

E: Emitter
C: Collector
B: Base

SANYO: PCP





2SB1121



2038

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1621

High Current Driver Applications

©1987

Applications

- . Voltage regulators, relay drivers, lamp drivers, electrical equipment.

Features

- . Adoption of FBET, MBIT processes.
- . Low collector-to-emitter saturation voltage.
- . Large current capacity and wide ASO.
- . Fast switching speed.
- . Very small size making it easy to provide high-density, small-sized hybrid IC's.

(): 2SB1121

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)30	V
Collector to Emitter Voltage	V_{CEO}	(-)25	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)2	A
Peak Collector Current	i_{cp}	(-)5	A
Collector Dissipation	P_C	500	mW
	P_C	Mounted on ceramic board (250mm ² x 0.8mm)	
		1.3	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

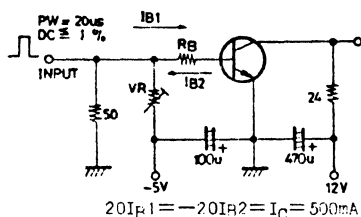
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)20\text{V}, I_E=0$		(-)0.1		μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$		(-)0.1		μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)2\text{V}, I_C=(-)100\text{mA}$	100		560	
	$h_{FE}(2)$	$V_{CE}=(-)2\text{V}, I_C=(-)1.5\text{A}$	65			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		150		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)1.5\text{A}, I_B=(-)75\text{mA}$		0.18	0.4	V
				(-0.35)	(-0.6)	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)1.5\text{A}, I_B=(-)75\text{mA}$		(-)0.85	(-)1.2	V

* The 2SB1121/2SD1621 are classified by 100mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400	280	U	560
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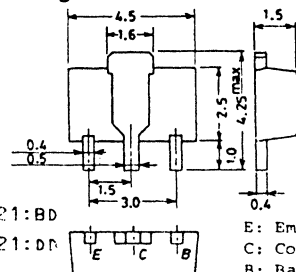
Switching Time Test Circuit

(For PNP, polarity is reversed.)



Case Outline 2038

(unit:mm)



Marking

2SB1121:BD

2SD1621:DR

E: Emitter
C: Collector
B: Base

SANYO: PCP

2SB1121/2SD1621

			min	typ	max	unit
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)30$			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	$(-)25$			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu A, I_C=0$	$(-)6$			V
Output Capacitance	c_{ob}	$V_{CB}=(-)10V, f=1MHz$		19 (32)		pF pF
Turn-ON Time	t_{on}	at Test Circuit		60 (60)		ns ns
Storage Time	t_{stg}	"		500 (350)		ns ns
Fall Time	t_f	"		25 (25)		ns ns

The rest is omitted. For characteristic curves, refer to the description of the 2SD1621.

2SB1123



2038

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1623

High Current Switching Applications

©1727

Applications

- Voltage regulators, relay drivers, lamp drivers, electrical equipment.

Features

- Adoption of FBET, MBIT processes.
- Low collector-to-emitter saturation voltage.
- Large current capacity and wide ASO.
- Fast switching speed.
- Very small size making it easy to provide high-density, small-sized hybrid IC's.

(): 2SB1123

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)60	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)6	V
Collector Current	I_C	(-)2	A
Peak Collector Current	i_{cp}	(-)4	A
Collector Dissipation	P_C	500	mW
	P_C^*	1.3	W
Junction Temperature	T_J	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

* Mounted on ceramic board ($250\text{mm}^2 \times 0.8\text{mm}$)

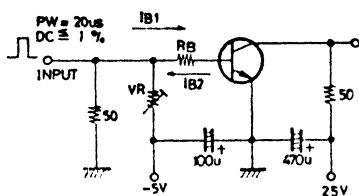
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)50\text{V}, I_E=0$			(-)100	nA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)100	nA
DC Current Gain	h_{FE1}^{**}	$V_{CE}=(-)2\text{V}, I_C=(-)100\text{mA}$	100		560	
	h_{FE2}	$V_{CE}=(-)2\text{V}, I_C=(-)1.5\text{A}$	40			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		150		MHz
Output Capacitance	C_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(22)12		pF

* The 2SB1123/2SD1623 are classified by $100\text{mA } h_{FE}$ as follows:

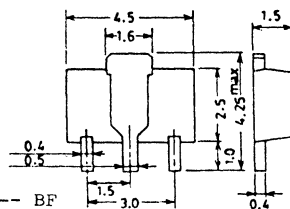
100	R	200	140	S	280	200	T	400	280	U	560
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Switching Time Test Circuit

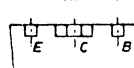


$20I_{B1} = -20I_{B2} = I_C = 500\text{mA}$
(For PNP, polarity is reversed.)

Case Outline 2038 (unit:mm)



Marking: 2SB1123 -- BF
2SD1623 -- DF



E: Emitter
C: Collector
B: Base

SANYO: PCP

2SB1123/2SD1623

			min	typ	max	unit
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)1A, I_B=(-)50mA$		$(-0.3)(-0.7)$		V
				0.15	0.4	
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)1A, I_B=(-)50mA$		$(-)0.9(-)1.2$		V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)60$			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	$(-)50$			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu A, I_C=0$	$(-)6$			V
Turn-ON Time	t_{on}	at specified Test Circuit		$(60)60$		ns
Storage Time	t_{stg}	"		$(450)550$		ns
Fall Time	t_f	"		$(30)30$		ns

The rest is omitted. For characteristic curves, refer to the description of the 2SD1623.

2SB1126



2038

PNP/NPN Epitaxial Planar
Silicon Transistors

2SD1626

Driver Applications

©1721

Applications

- . Relay drivers, hammer drivers, lamp drivers, motor drivers.

Features

- . High DC current gain (4000 or greater).
- . Large current capacity.
- . Very small size making it easy to provide high-density, small-sized hybrid IC's.

(): 2SB1126

Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CB0}	(-)80	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)10	V
Collector Current	I_C	(-)1.5	A
Peak Collector Current	i_{cp}	(-)3	A
Collector Dissipation	$P_C(1)$	500	mW
	$P_C(2)$	Monuted on ceramic board (250mm ² x 0.8mm)	1.5
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

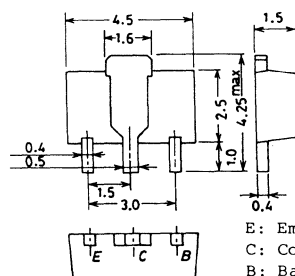
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CE}=(-)40V, I_E=0$			(-)100	nA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)8V, I_C=0$			(-)100	nA
DC Current Gain	h_{FE1}	$V_{CE}=(-)2V, I_C=(-)500mA$	4000			
	h_{FE2}	$V_{CE}=(-)2V, I_C=(-)10mA$	3000			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		120		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500mA, I_B=(-)0.5mA$		(-)0.9	(-)1.5	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500mA, I_B=(-)0.5mA$		(-)1.5	(-)2.0	V
C-B Breakdown Voltage	$V_{(BR)CB0}$	$I_C=(-)10uA, I_E=0$		(-)80		V
C-E Breakdown Voltage	$V_{(BR)CE0}$	$I_C=(-)1mA, R_{BE}=\infty$		(-)50		V
E-B Breakdown Voltage	$V_{(BR)EB0}$	$I_E=(-)10uA, I_C=0$		(-)10		V

Case Outline 2038

(unit:mm)

Marking 2SB1126 : BI
2SD1626 : DI



E: Emitter
C: Collector
B: Base

SANYO: PCP

For details, refer to the description of the 2SD1626.

Page	Page	Page
2SC536243	2SC3088389	2SC3449533
2SC536K243	2SC3089392	2SC3450536
2SC693245	2SC3090395	2SC3451539
2SC930247	2SC3114398	2SC3455542
2SC1570264	2SC3116401	2SC3456545
2SC1571264	2SC3117404	2SC3457548
2SC1571L264	2SC3134405	2SC3458551
2SC1755267	2SC3135408	2SC3459554
2SC1756267	2SC3142411	2SC3460557
2SC1757267	2SC3143416	2SC3461560
2SC2078269	2SC3144417	2SC3467563
2SC2210272	2SC3145420	2SC3468567
2SC2228A276	2SC3149423	2SC3479571
2SC2228Y276	2SC3150426	2SC3480574
2SC2271279	2SC3151429	2SC3481577
2SC2274281	2SC3152432	2SC3482580
2SC2274K281	2SC3153435	2SC3483583
2SC2314284	2SC3173438	2SC3484586
2SC2344286	2SC3174440	2SC3485589
2SC2362289	2SC3175442	2SC3486592
2SC2362K289	2SC3176444	2SC3495595
2SC2621293	2SC3183446	2SC3502598
2SC2812295	2SC3184449	2SC3503602
2SC2813297	2SC3189452	2SC3504606
2SC2814300	2SC3253454	2SC3552608
2SC2839304	2SC3254457	2SC3576611
2SC2840308	2SC3255460	2SC3589614
2SC2857312	2SC3277463	2SC3590617
2SC2909315	2SC3292466	2SC3591619
2SC2910318	2SC3293469	2SC3595621
2SC2911321	2SC3294472	2SC3596624
2SC2912324	2SC3330475	2SC3597628
2SC2960327	2SC3331478	2SC3598632
2SC2998330	2SC3332481	2SC3599636
2SC2999333	2SC3361484	2SC3600640
2SC3000338	2SC3382486	2SC3601644
2SC3038342	2SC3383489	2SC3636646
2SC3039345	2SC3392492	2SC3637649
2SC3040348	2SC3393496	2SC3638652
2SC3042351	2SC3395500	2SC3642655
2SC3064354	2SC3396502	2SC3643658
2SC3065357	2SC3397504	2SC3644661
2SC3066360	2SC3398506	2SC3645664
2SC3067362	2SC3399508	2SC3648667
2SC3068365	2SC3400510	2SC3650670
2SC3069368	2SC3401512	2SC3651673
2SC3070371	2SC3402514	2SC3653676
2SC3071374	2SC3416516	2SC3654678
2SC3083377	2SC3417520	2SC3655680
2SC3085380	2SC3446524	2SC3656682
2SC3086383	2SC3447527	2SC3675684
2SC3087386	2SC3448530	2SC3676687

2SC-TYPE (HF NPN)

All specifications and characteristics shown on the following pages are for standard products. Data shown on individual figures, except P_C derating curve and ASO, are represented by typical values. Ambient temperature T_a is 25°C unless otherwise specified.

2SC536, 536K



2000B



2003A

NPN Planar
Silicon Transistors

Small Signal, General-Purpose Amp Applications

©333H

Features

- The 2SC536 is classified into 2 types of SP, NP according to the case outline.
- The NP type is subclassified into 2 subtypes according to the breakdown voltage.
- Suitable for use in a wide range of applications from low frequency amplification to AM IF amplification.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

		2SC536SP	2SC536NP	2SC536KNP	unit
Collector to Base Voltage	V_{CB0}	40	40	55	V
Collector to Emitter Voltage	V_{CE0}	30	30	50	V
Emitter to Base Voltage	V_{EB0}	5	5	5	V
Collector Current	I_C	100	100	100	mA
Peak Collector Current	i_{cp}	300	300	300	mA
Collector Dissipation	P_C	200	400	400	mW
Junction Temperature	T_j	125	125	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to +125	-55 to +125	-55 to +125	$^\circ\text{C}$

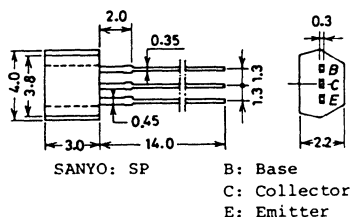
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=35\text{V}, I_E=0$			1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4\text{V}, I_C=0$			1.0	μA
DC Current Gain	h_{FE}^*	$V_{CE}=6\text{V}, I_C=1\text{mA}$	60*	320	960*	
Gain Bandwidth Product	f_T	$V_{CE}=6\text{V}, I_C=1\text{mA}$		100		MHz
Output Capacitance	C_{ob}	$V_{CB}=6\text{V}, f=1\text{MHz}$ [2SC536SP]		3.0		pF
		[2SC536NP, KNP]		3.5		pF
Collector-Base Time Constant	$\tau_{bb'c_c}$	$V_{CB}=6\text{V}, I_C=1\text{mA}, f=31.9\text{MHz}$		250		ps
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=50\text{mA}, I_B=5\text{mA}$			0.5	V

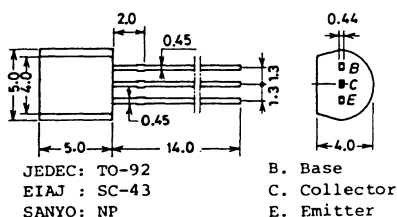
*2SC536 is graded as follows by h_{FE} at 1A:

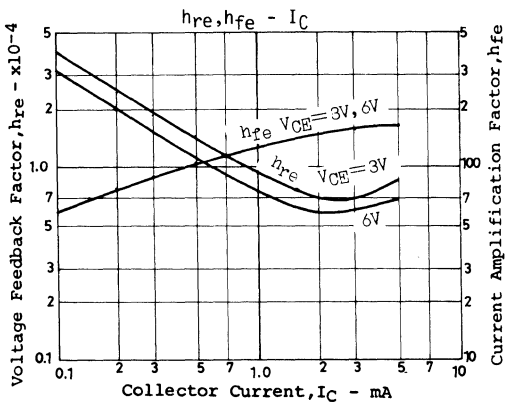
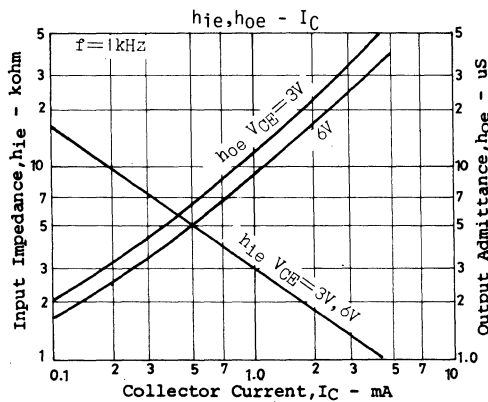
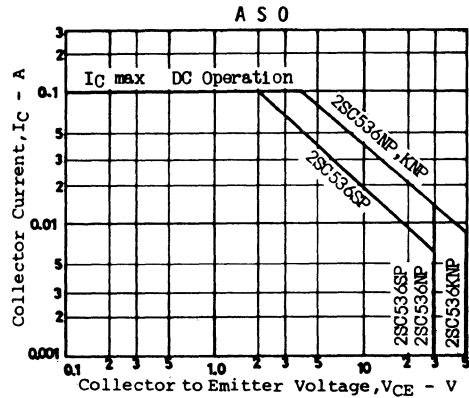
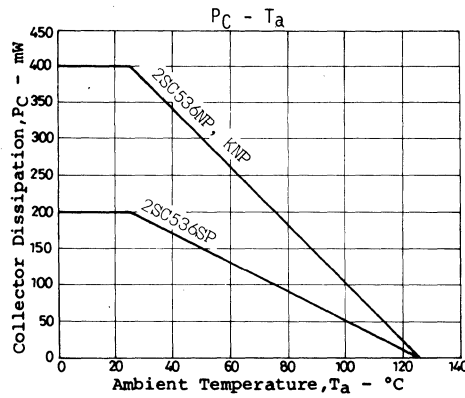
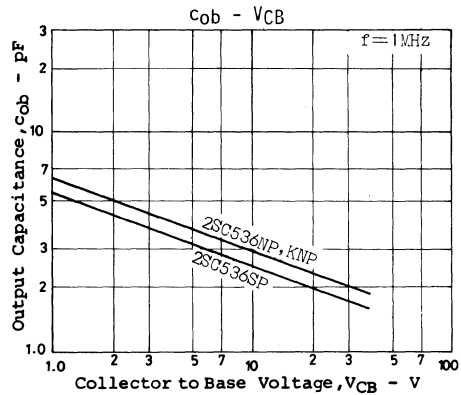
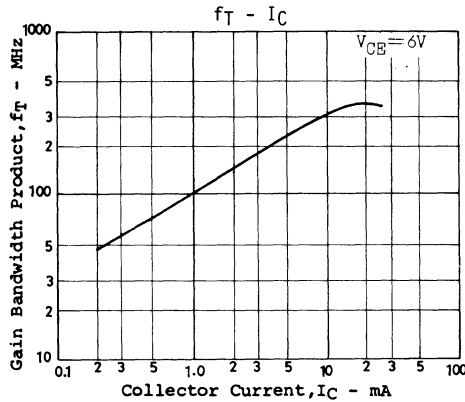
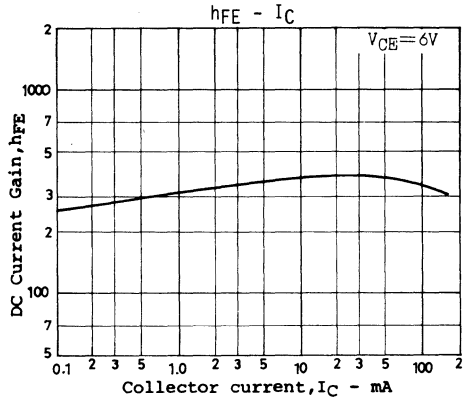
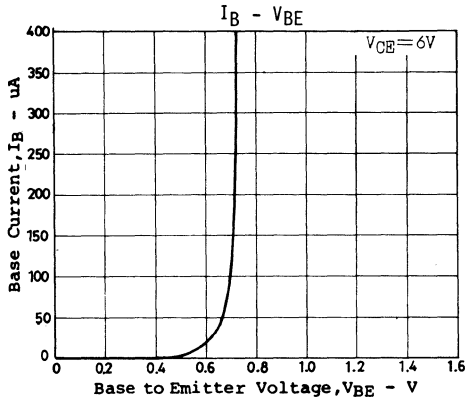
60	D	120	100	E	200	160	F	320	280	G	560	480	H	960
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Case Outline 2000B
(unit:mm)



Case Outline 2003A
(unit:mm)





2003A

NPN Planar
Silicon Transistor

Low Frequency, Low Noise Amp Applications

(E)257D

Absolute Maximum Ratings at Ta=25°C

Absolute Maximum Ratings at Ta=25°C			unit
Collector to Base Voltage	V _{CBO}	40	V
Collector to Emitter Voltage	V _{CEO}	20	V
Emitter to Base Voltage	V _{EBO}	5	V
Collector Current	I _C	50	mA
Collector Dissipation	P _C	100	mW
Junction Temperature	T _j	125	°C
Storage Temperature	T _{stg}	-40 to +125	°C

Electrical Characteristics at Ta=25°C

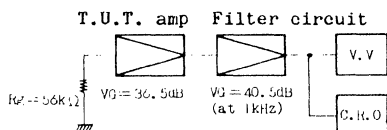
Electrical Characteristics at Ta=25°C			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=35V, I_E=0$			1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4V, I_C=0$			1.0	μA
DC Current Gain	h_{FE}^*	$V_{CE}=6V, I_C=1mA$	160		960	
Gain Bandwidth Product	f_T	$V_{CE}=6V, I_C=1mA$		100		MHz
Output Capacitance	c_{ob}	$V_{CB}=6V, f=1MHz$		3.5		pF
Output Noise Voltage	V_{NO}	$V_{CC}=30V, I_C=1mA, R_g=56k\Omega$ $V_G=77dB, f=1kHz$ (See Circuit.)			105	mV

Output Noise Voltage(Peak)

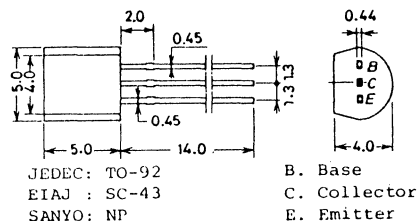
* The 2SC693 is classified by 1mA h_{FE} as follows:

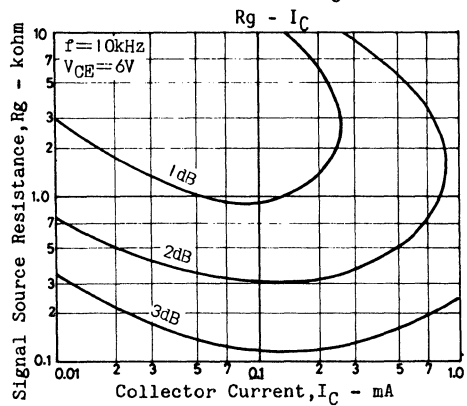
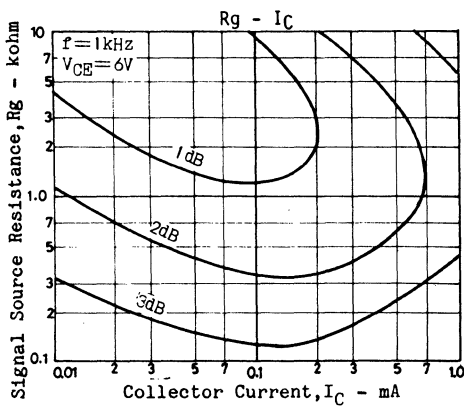
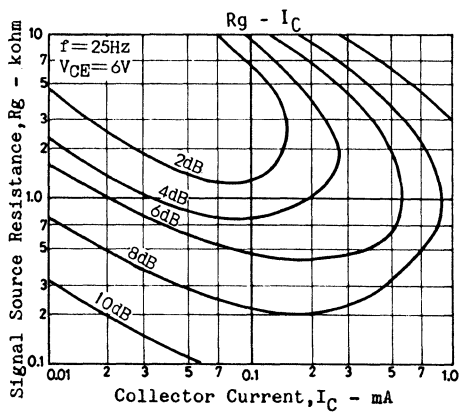
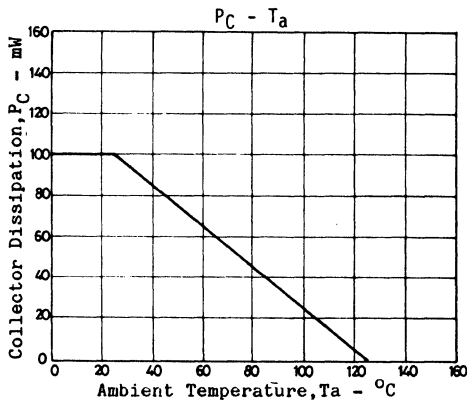
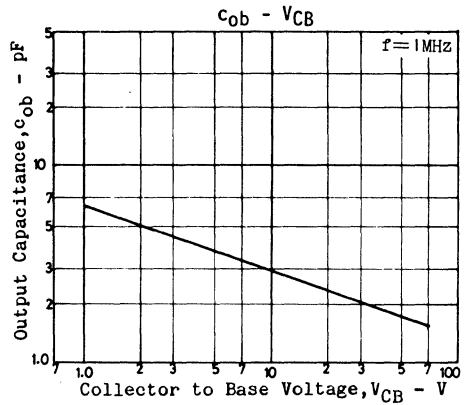
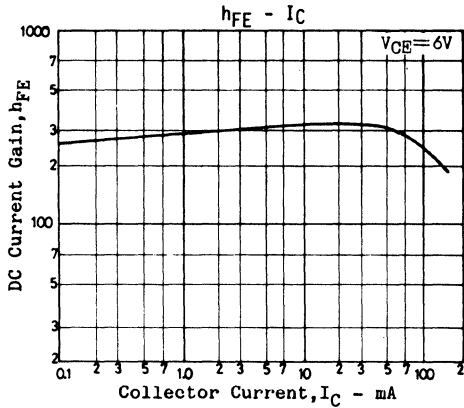
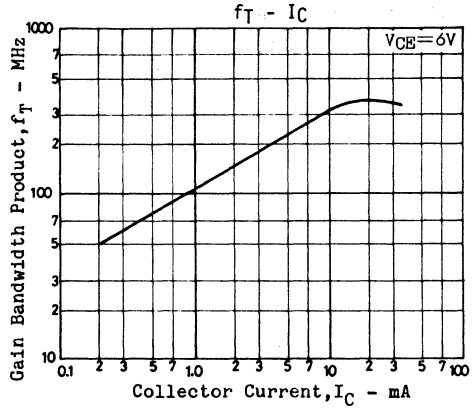
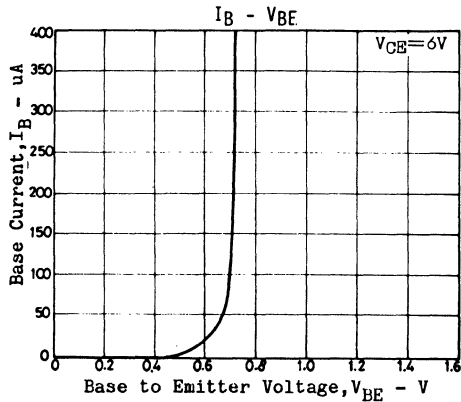
160	F	320	280	G	560	480	H	960
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Noise Test Circuit

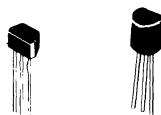


Case Outline 2003A
(unit:mm)





2SC930



2000B

2003A

NPN Epitaxial Planar
Silicon Transistor

AM Converter, FM RF·IF Amp Applications

©545D

The 2SC930 has two types of package: SP and NP.

Use

- FM RF amp, mixer, OSC, converter, and IF amplifier.

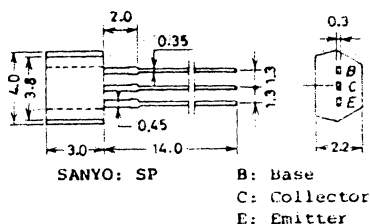
Absolute Maximum Ratings at Ta=25°C		2SC930SP	2SC930NP	unit
Collector to Base Voltage	V _{CB0}	30	30	V
Collector to Emitter Voltage	V _{CE0}	20	20	V
Emitter to Base Voltage	V _{EB0}	5	5	V
Collector Current	I _C	30	30	mA
Collector Dissipation	P _C	120	250	mW
Junction Temperature	T _j	125	125	°C
Storage Temperature	T _{stg}	-40 to +125	-55 to +125	°C

Electrical Characteristics at Ta=25°C		min			typ	max	unit
Collector Cutoff Current	I _{CB0}	V _{CB} =10V, I _E =0				1	uA
Emitter Cutoff Current	I _{EB0}	V _{EB} =4V, I _C =0				1	uA
DC Current Gain	h _{FE} *	V _{CE} =6V, I _C =1mA			40*	80	320*
Gain Bandwidth Product	f _T	V _{CE} =6V, I _C =1mA			170	300	MHz
Reverse Transfer capacitance	C _{re}	V _{CB} =6V, I _C =1MHz (2SC930SP) 0.8				1.6	pF
		V _{CB} =6V, f=1MHz (2SC930NP) 1.0				1.3	1.8
Base to Collector	r _{bb'} ·C _C	V _{CE} =6V, I _C =1mA			20	36	pS
Time Constant		f=31.9MHz					
Noise Figure	NF	V _{CE} =6V, I _C =1mA			4.0		dB
		f=100MHz					
Turn-on Time	t _{on}	V _{IN} =+12V, V _{BB} =-3V, appointed circuit			30		ns
Turn-off Time	t _{off}	V _{IN} =-12V, V _{BB} =+3V, appointed circuit			30		ns

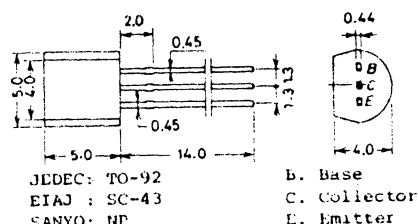
*The 2SC930 es graded as follows by 1mA h_{FE}:

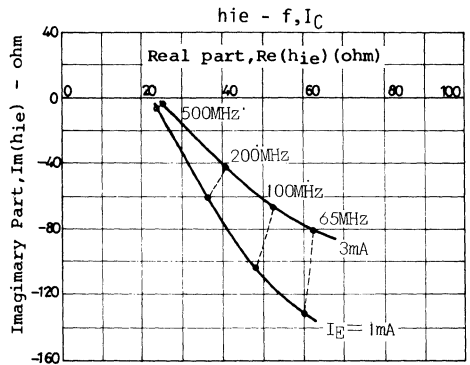
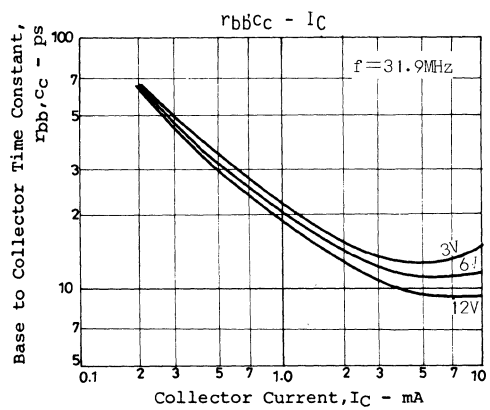
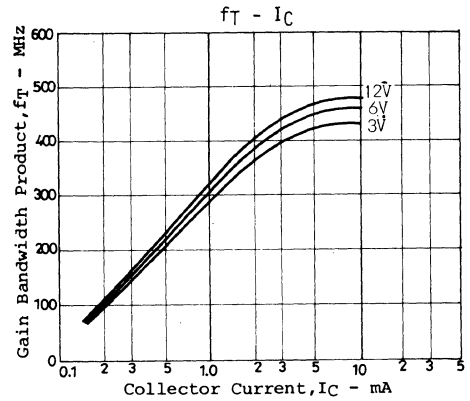
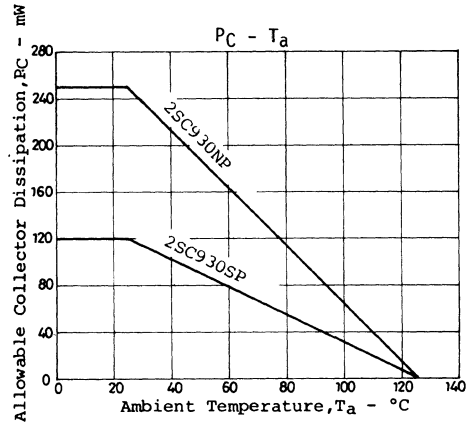
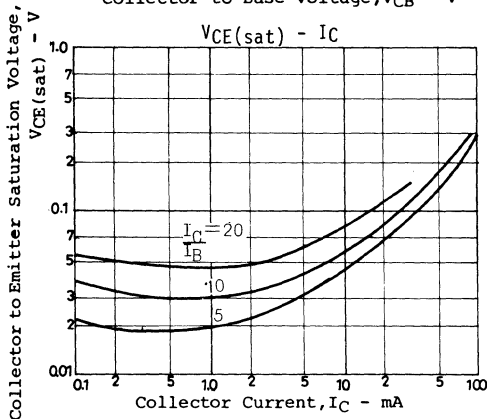
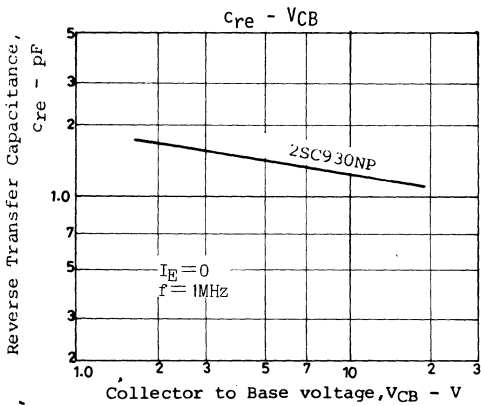
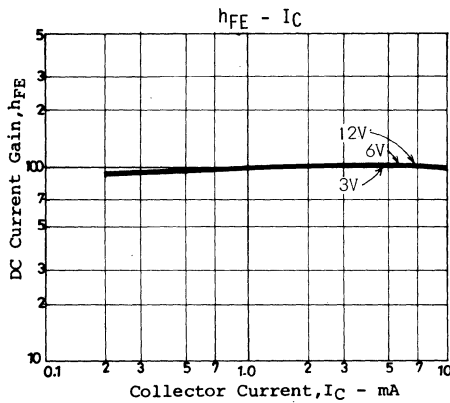
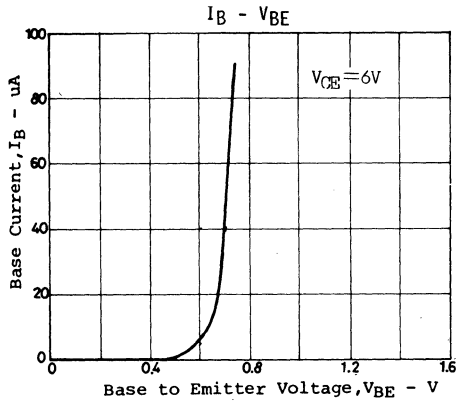
40	C	80	60	D	120	100	E	200	160	F	320
----	---	----	----	---	-----	-----	---	-----	-----	---	-----

Case Outline 2000B
(unit:mm)

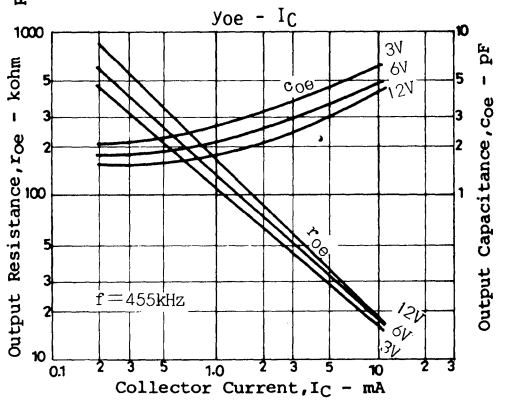
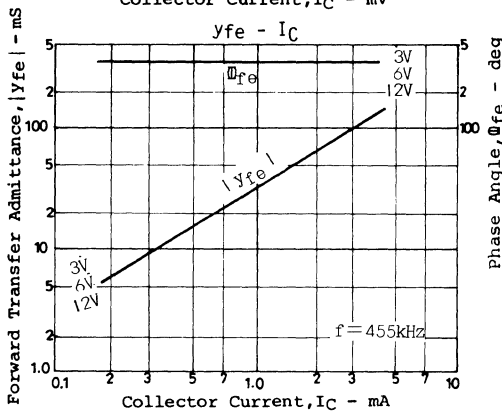
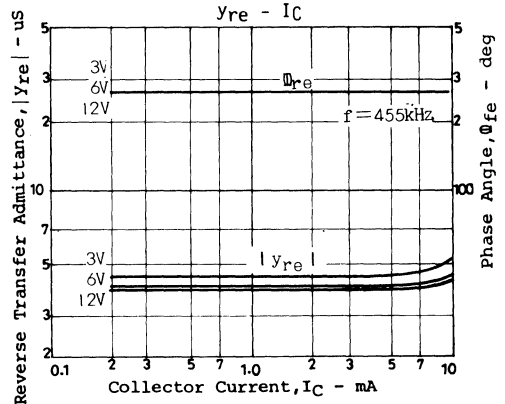
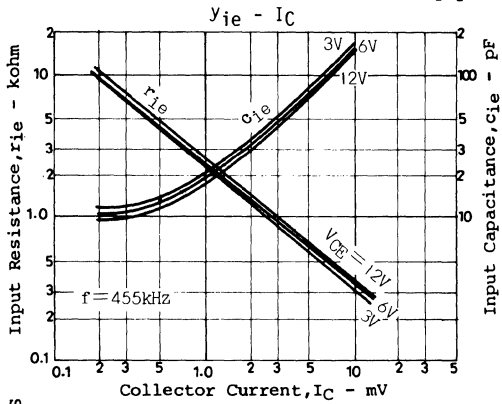


Case Outline 2003A
(unit:mm)

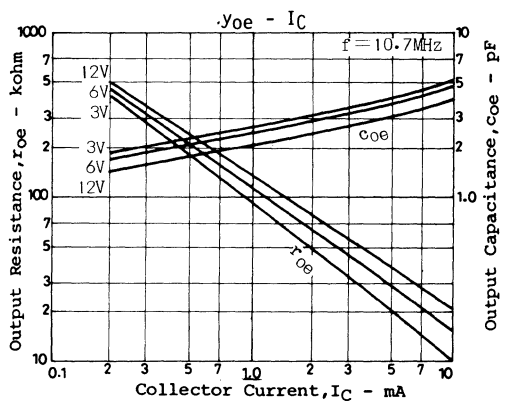
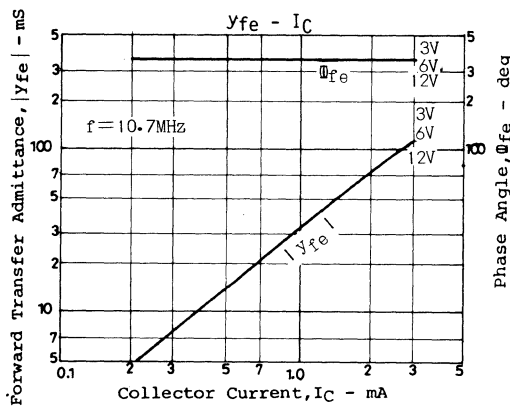
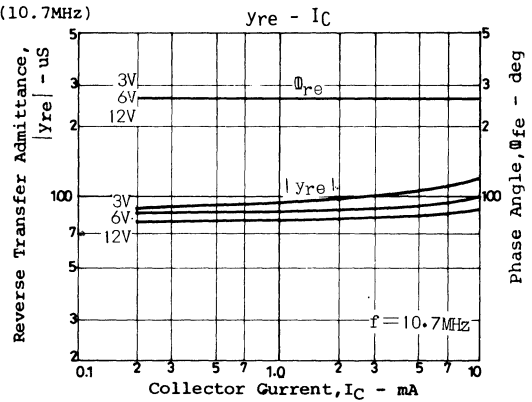
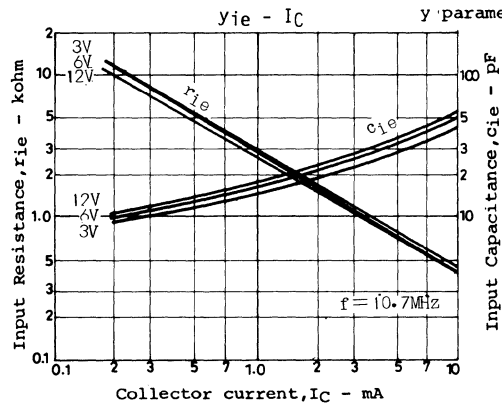


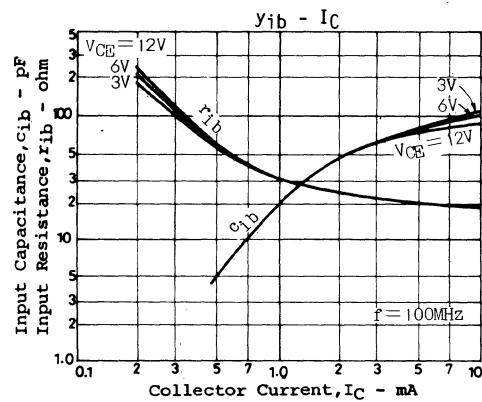
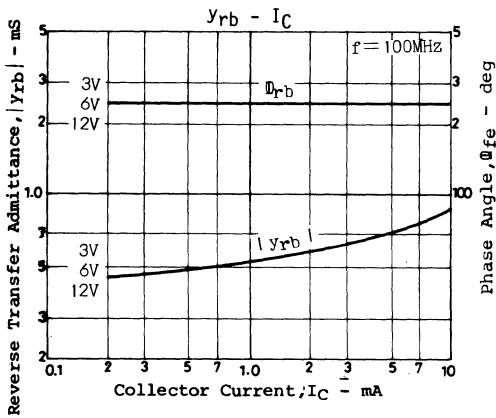
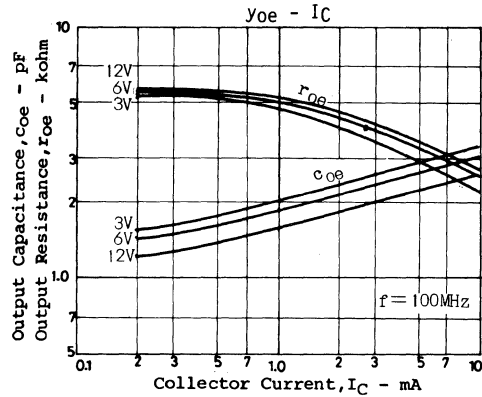
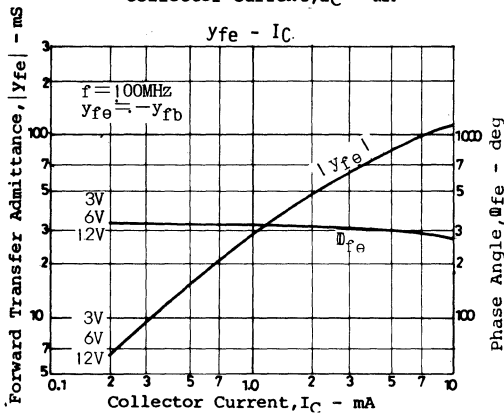
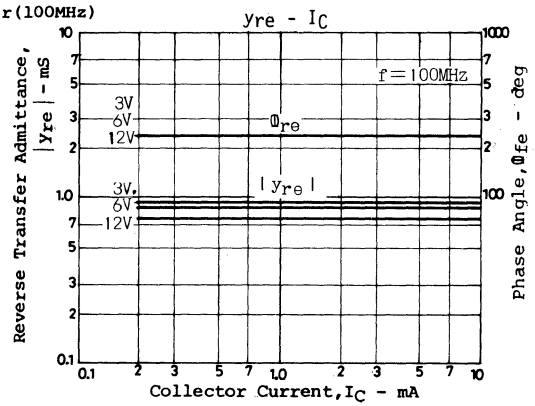
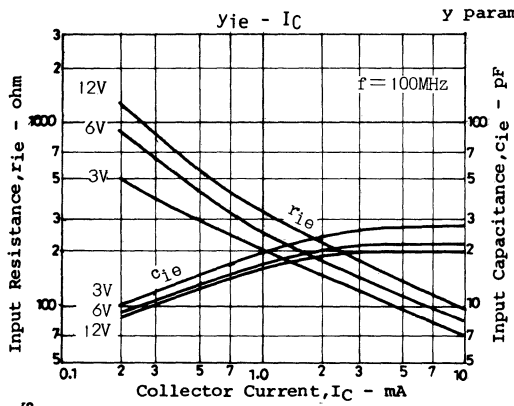


y parameter(455kHz)



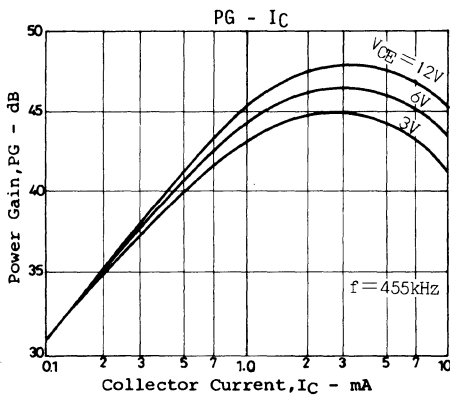
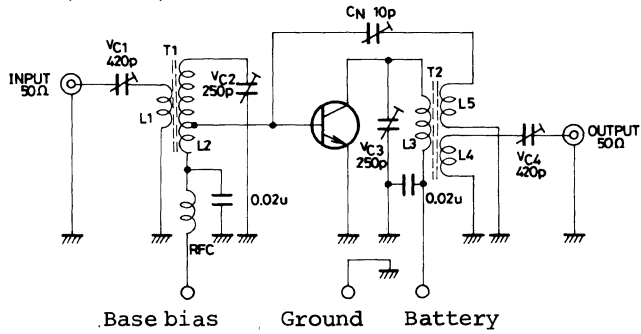
y parameter(10.7MHz)





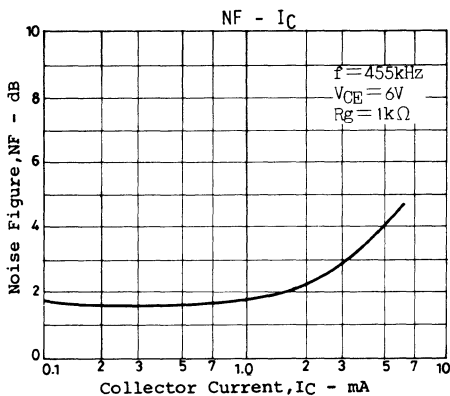
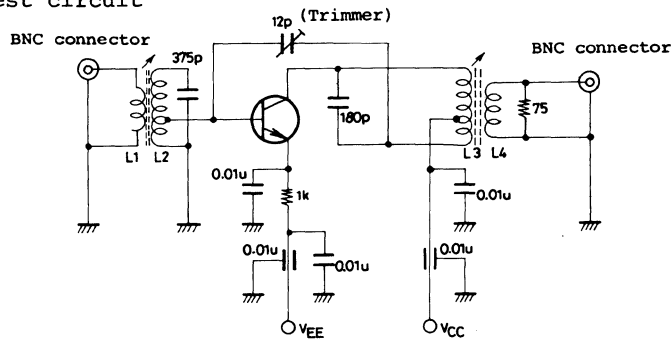
Amplification Characteristic (455kHz)

PG test circuit



T1 : L1 108T, L2 144T, tap 26T
 T2 : L3 144T, L4 105T, L5 36T
 10mm square IFT for 455kHz
 Core $Q_0=110$
 Wire diameter : 0.1mm ϕ enameled wire

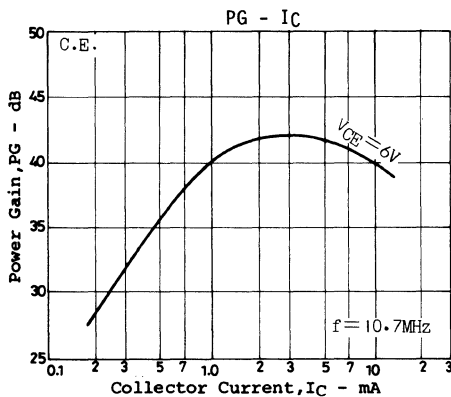
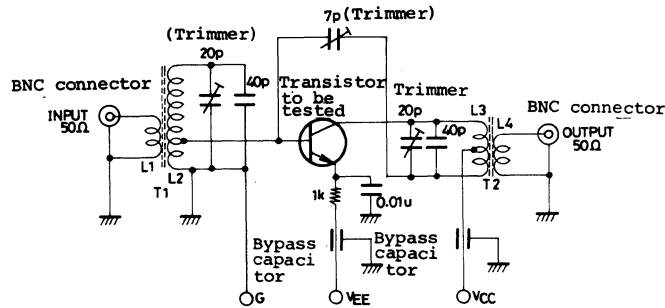
Noise figure test circuit



L1 : 8T
 L2 : 130T, tap:center
 L3 : 147T, tap:50T from collector side
 L4 : 7T

Amplification Characteristic (10.7MHz)

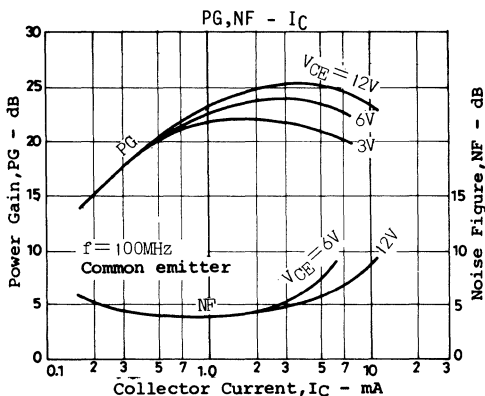
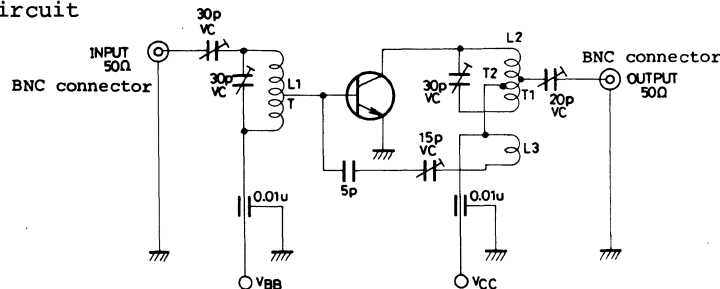
PG test circuit



- L1 : 3T
 L2 : 18T, tap:12T from GND side
 L3 : 18T, tap:13T from collector side
 L4 : 2T

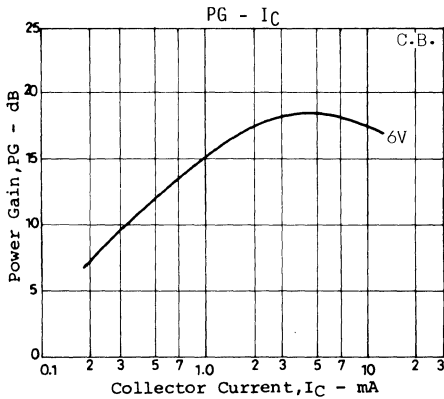
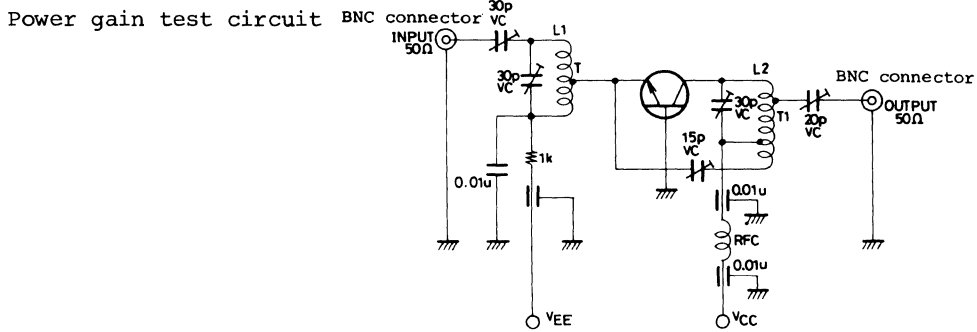
Amplification Characteristic (100MHz) Common Emitter

Power gain test circuit



- L1 : 3T, tap:center
 wire diameter 1.5mm enameled wire,
 coil diameter 18mm
 L2 : 4T, T1:1.5T from collector side,
 T2:3T from collector side, wire
 diameter, coil diameter:same as
 for L1
 L3 : 1/2T, wire diameter, coil dia-
 meter:same as for L1

Amplification Characteristic (100MHz) Common Base

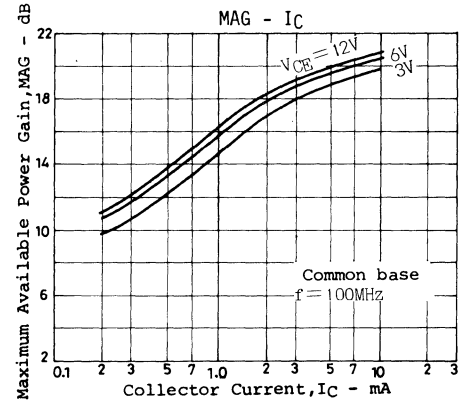
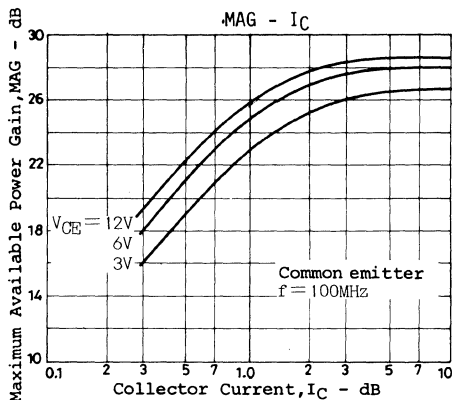
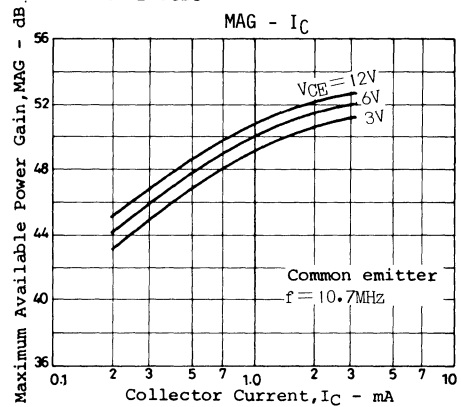
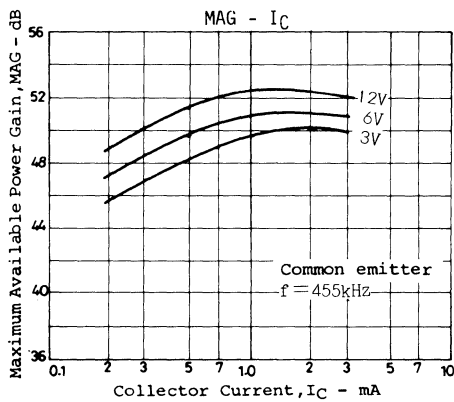


L1 : 3T, tap:center

wire diameter 1.5mm enameled wire
coil diameter 18mm

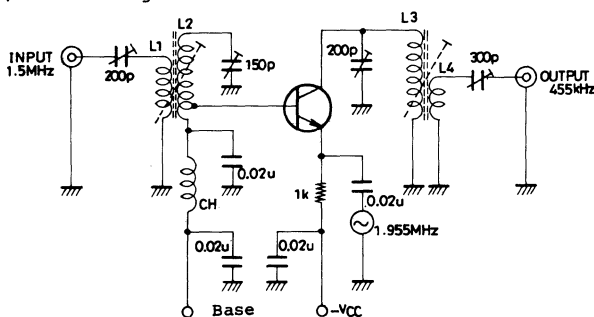
L2 : 4T, T1:1.5T from collector side
T2:2.5T from collector side
wire diameter 1mm Sn-plated wire
coil diameter 18mm

Maximum Available Power Gain Characteristic



Conversion Characteristic (1.5MHz)

Mixing gain, noise figure test circuit



Coil at input side (455kHz)

L1 : 45T

```
L2 : 64T (tap:15T)
```

 $Q_0=100, L=112\mu H$

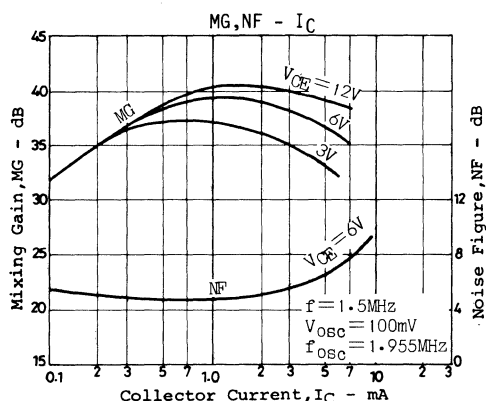
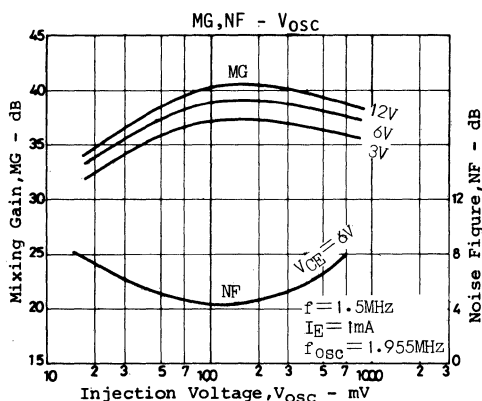
Coil at output side (455kHz)

L3 : 144T

 $Q_0=135, L=630\mu H$

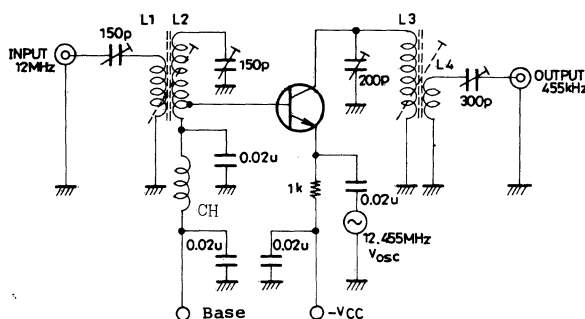
L4 : 96T

IFT for 455kHz



Conversion Characteristic (12MHz)

Mixing gain, noise figure test circuit



Coil at input side(12MHz)

L1 : 7T

L2 : 13T (tap:4T)

$$Q_0=110, L=3.1\mu H$$

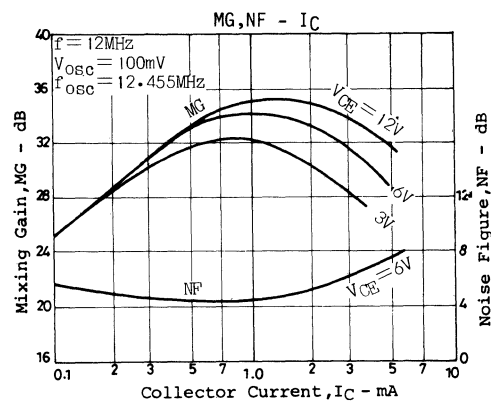
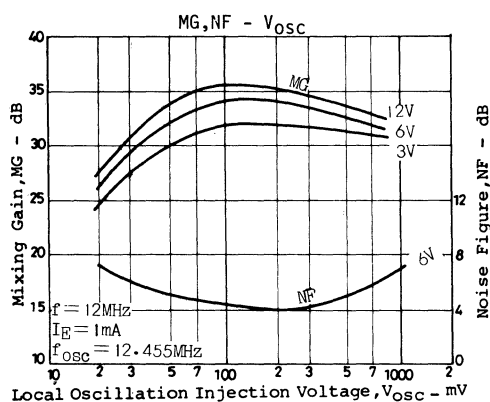
Coil at output side (455kHz)

L3 : 144T

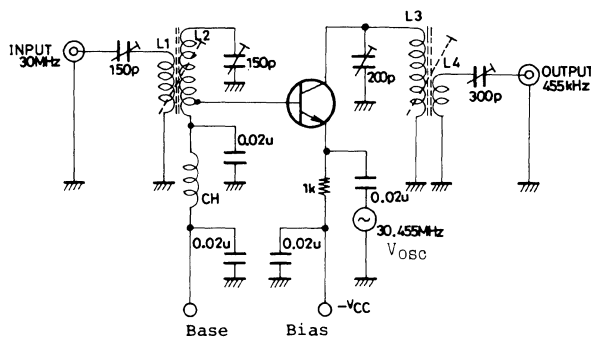
 $Q_0=135, L=630\mu H$

L4 : 96T

IFT for 455kHz



Conversion Characteristic (30MHz) Mixing gain, noise figure test circuit



Coil at input side(30MHz)

L1 : 2T

L2 : 8T (tap:2T)

$Q_0=80, L=0.8\mu\text{H}$

10 ϕ core bobbin

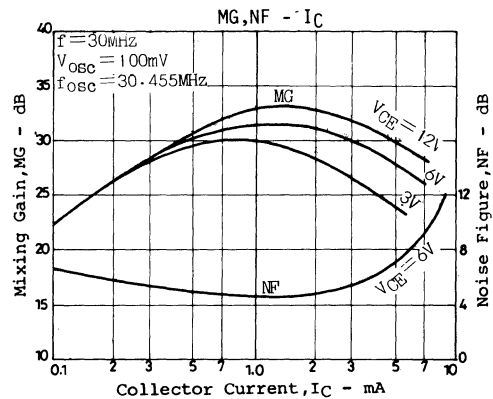
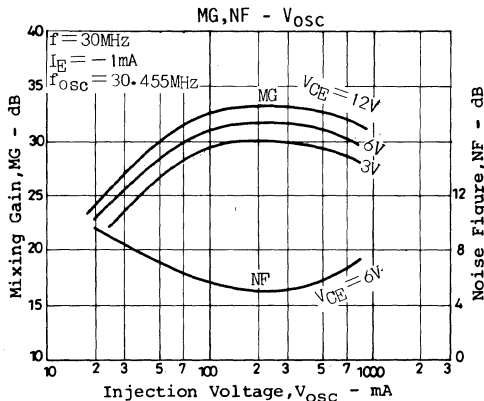
Coil at output side(455kHz)

L3 : 144T

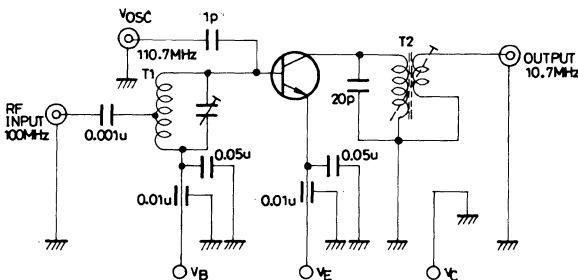
$Q_0=135, L=630\mu\text{H}$

L4 : 96T

IFT for 455kHz



Conversion Characteristic (100MHz) Common Emitter Mixing gain, noise figure test circuit



T1 : 1.0 ϕ Sn-plated wire, 4T, in-side diameter 8 ϕ

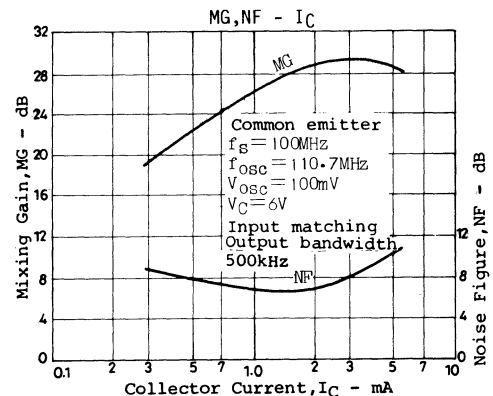
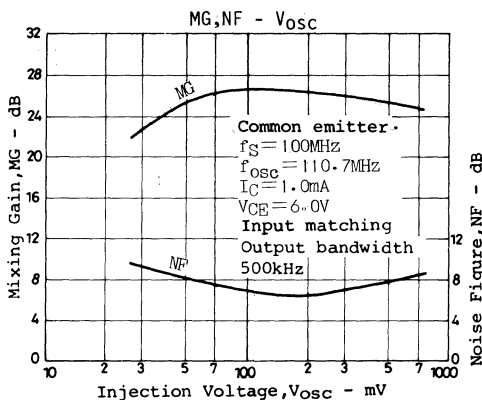
Tap is adjusted to obtain input matching.

T2 : 0.1 ϕ formal wire, primary side 22T

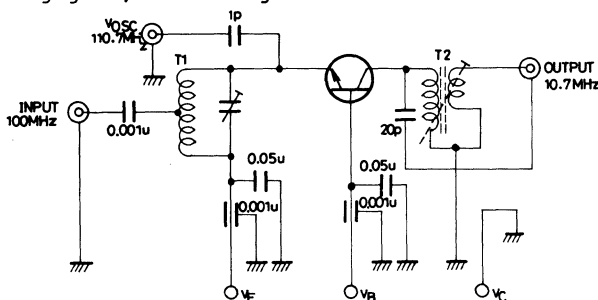
0.1 ϕ formal wire, secondary side 2T

No-load Q_0 80 to 85

output bandwidth approx. 500kHz

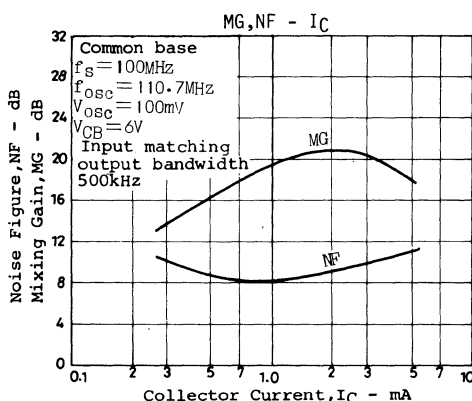
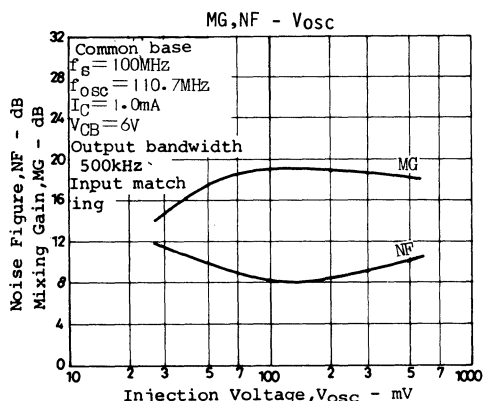


Conversion Characteristic (100MHz) Common Base
Mixing gain, noise figure test circuit



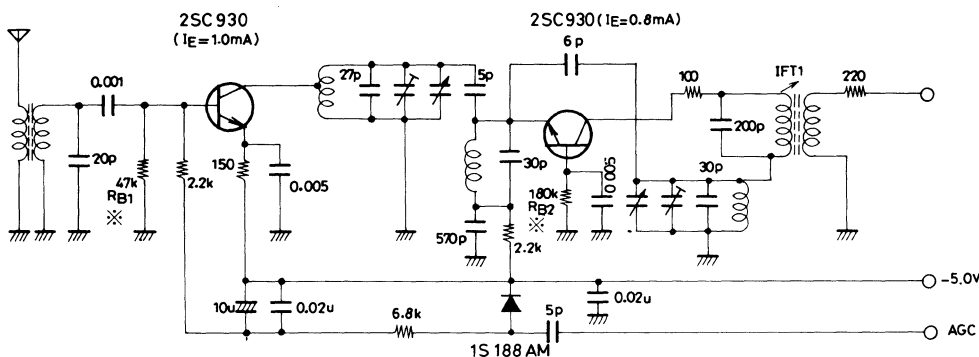
T1 : 1.0 ϕ Sn-plated wire, 7T, 8 ϕ
Tap is adjusted to obtain input
100MHz matching.

T2 : Primary 0.1 ϕ formal wire, 22T
secondary 0.1 ϕ formal wire, 2T
no-load Q_0 approx. 80 to 85
output bandwidth approx. 500kHz



Sample Application Circuit 1: FM tuner

RF : Common emitter



Enameled wire	0.6 ϕ
Antenna coil	7turns : 5turns
	5 ϕ air-core bifilar winding
RF coil	4turns
	tap:1T from GND side
IF Trap coil	12 $\frac{1}{2}$ turns
	5 ϕ air-core
Osc coil	3turns
	tap:2T from GND side
IFT ₁	7turns : 1turn
	Qo 80 (200pF tuning)
	0.12 ϕ enameled wire

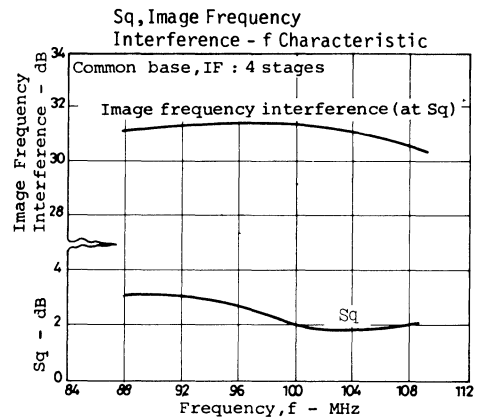
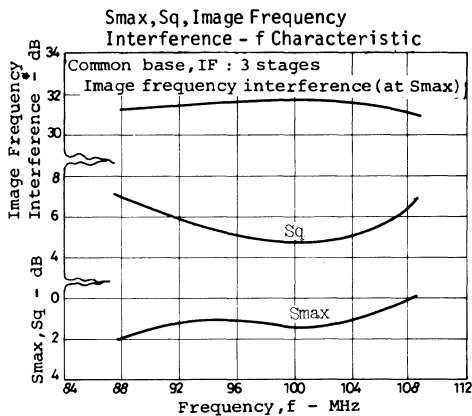
* Bias resistor

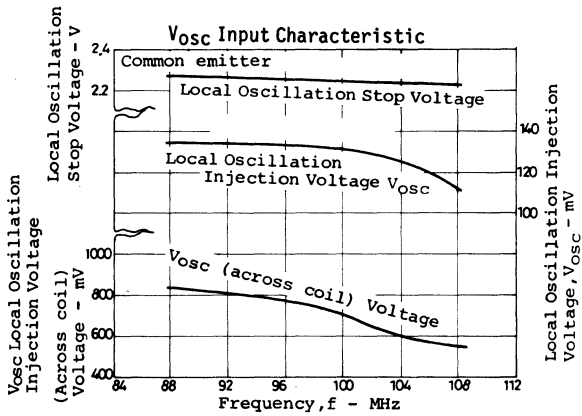
h_{FE}	C	D	E	
R _{B1}	47k	51k	56k	ohm
R _{B2}	180k	240k	270k	ohm

Variable capacitor
C min 4.5pF, C max 24.5pF

Table of Receiver Test Results

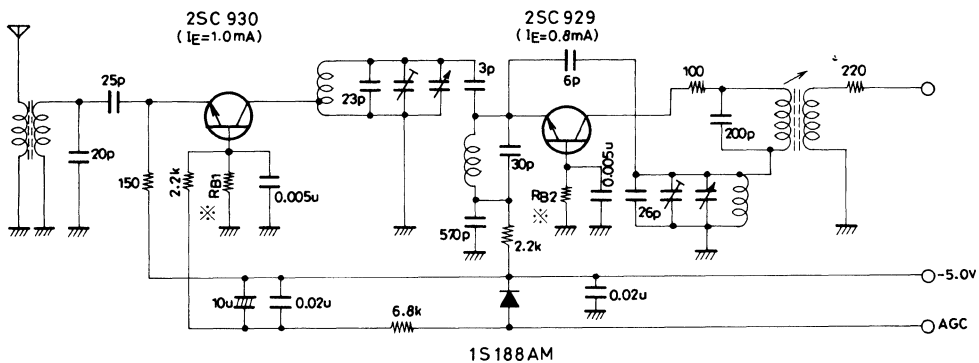
Test Item	Test condition	Test Frequency	IF : 3 Stages	IF : 4 Stages
Maximum Sensitivity Smax	Mod. 30% 400Hz	88 MHz 98 MHz 108 MHz	-2.2 dB -1.0 dB 0 dB	
Usable Sensitivity Sq	S/N 30dB	88 MHz 98 MHz 108 MHz	6.8 dB 5.2 dB 6.3 dB	2.8 dB 2.1 dB 2.0 dB
Selectivity (dB)	Input 60dB/-3dB width	98 MHz	226kHz	197kHz
Distortion (%)	Input 60dB	98 MHz	1.20% (Mod. 30%) 1.25% (Mod. 100%)	1.18% (Mod. 30%) 1.80% (Mod. 100%)
Image Frequency Interference (dB)	Maximum Sensitivity	108 MHz	31.0dB (at Smax)	30.4dB (at Sq)
IF Interference (dB)	Maximum Sensitivity	88 MHz	40.3dB (at Smax)	45.2dB (at Sq)
Local Oscillation Stop Voltage (V)		88 MHz 98 MHz 108 MHz	2.25 V 2.25 V 2.22 V	Same as left " "
Local Oscillation Voltage (mV)		88 MHz 98 MHz 108 MHz	135 mV 135 mV 110 mV	" " "
Large Input Chara- cteristic		No abnormality at 100dB input in the range of 88 to 108MHz		"
3dB limiting		98 MHz	28.7 dB	11.2 dB
Remarks	Voltage gain in audio section (f=400Hz) 54dB Standard output (8ohm load) 50mW			





Sample Application Circuit 2 : FM tuner

RF : Common base



Enameled wire 0.6 ϕ

Antenna coil 7turns : 5turns

RF coil 5 ϕ air-core, bifilar winding

IF Trap coil 4turns

OSC coil tap : 1T from GND side

IFT1 12 $\frac{1}{2}$ turns, air-core

3turns

tap : 1T from GND side

14turns : 2turns

(S-125)

Q₀=70

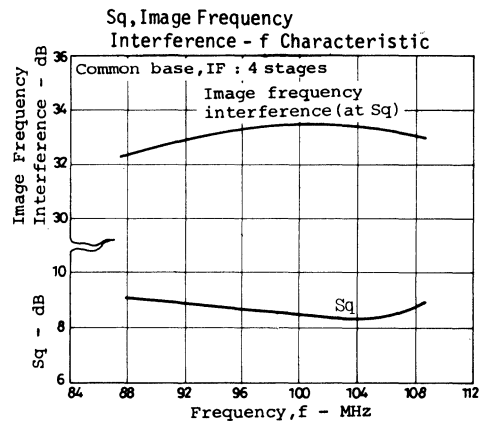
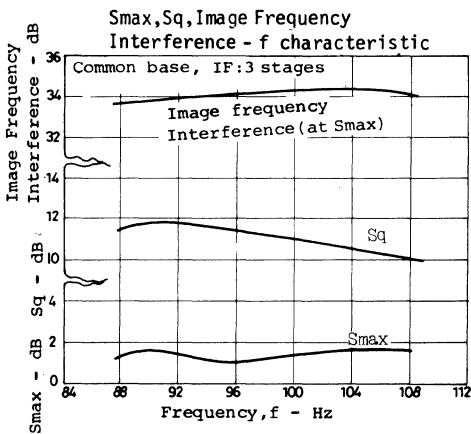
* Bias resistor

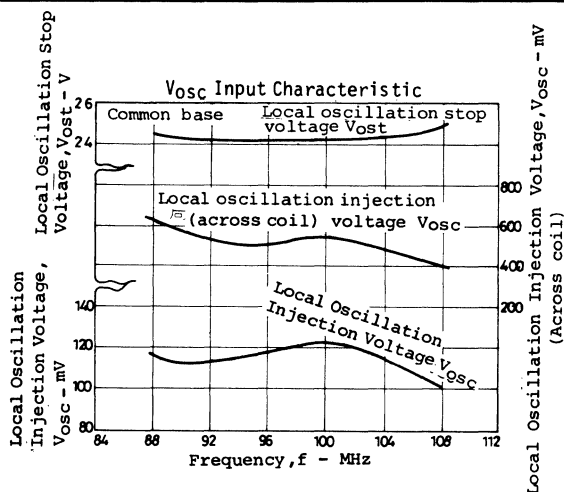
hFE	C	D	E	
R _{B1}	47k	51k	56k	ohm
R _{B2}	180k	240k	270k	ohm

Variable capacitor C_{min} 4.5pF C_{max} 24.5pF

Table of Receiver Test Results

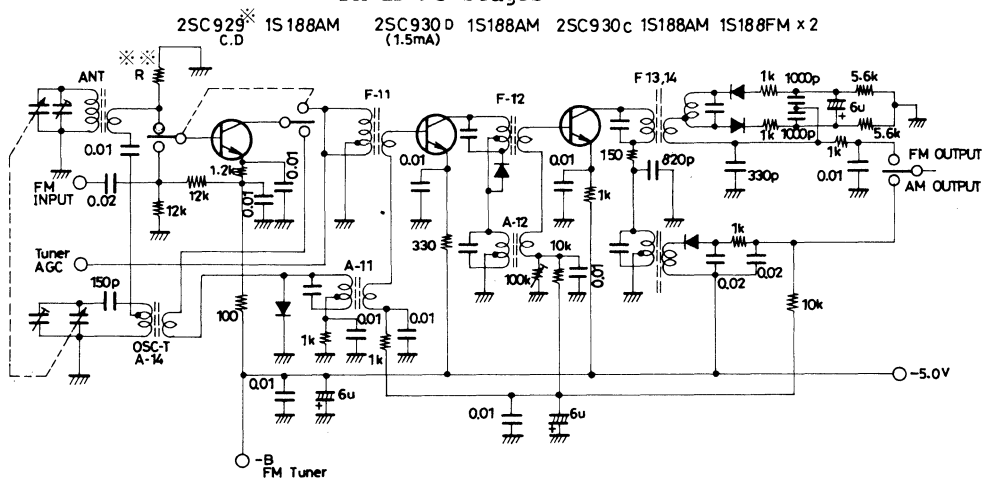
Test Item	Test Condition	Test Frequency	IF : 3 Stages	IF : 4 Stages
Maximum Sensitivity S _{max}	Mod. 30% 400Hz	88 MHz 98 MHz 108 MHz	1.2 dB 1.5 dB 1.7 dB	
Usable Sensitivity S _q	S/N 30dB	88 MHz 98 MHz 108 MHz	11.8 dB 11.0 dB 10.1 dB	8.9 dB 8.5 dB 8.7 dB
Selectivity (dB)	Input 60dB/ -3dB	98 MHz	235kHz	180kHz
Distortion (%)	Input 60dB Mod. 30%	98 MHz	1.00 %	1.20 %
	Input 60dB Mod. 100%	98 MHz	1.03 %	2.07 %
Image Frequency Interference (dB)	Maximum Sensitivity	108 MHz	33.9dB(At S _{max})	33.1dB(At S _q)
IF Interference(dB)	Maximum Sensitivity	88 MHz	72.3dB(At S _{max})	70.9dB(At S _q)
Local Oscillation Stop Voltage (V)		88 MHz	2.41 V	Same as above
		98 MHz	2.42 V	"
		108 MHz	2.48 V	"
Local Oscillation Voltage (mV)		88 MHz	117 mV	"
		98 MHz	120 mV	"
		108 MHz	100 mV	"
Large Input Chara- cteristic		No abnormality at 100dB input in the range of 88 to 108MHz		"
3dB Limiting		98 MHz	29.7 dB	18.0 dB
Remarks	Voltage gain in audio section (f=400MHz) 54dB Standard output (8ohm load) 50mW			





Sample Application Circuit 3 : FM/AM IF circuit + AM converter

FM IF : 3 stages



*	Emitter current	Collector voltage
FM mode	1.5 mA	3.2 V
AM mode	0.5 mA	4.4 V

(Note) Semifixed resistor of 100kohm is adjusted so that emitter current of 2SC930 at the 3rd stage becomes 1.5mA.

Variable capacitor PVC-2FXG

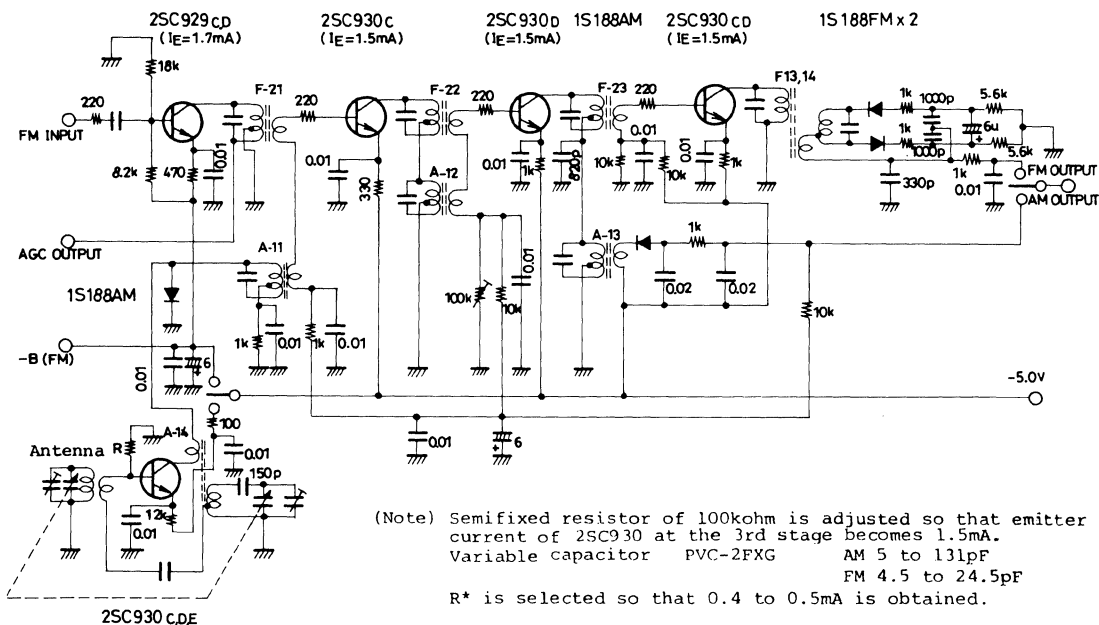
AM 5. to 131pF

FM 4.5 to 24.5pF

R* is selected so that 0.4 to 0.5mA is obtained.

hFE	C	D	E
R**	510kohm	750kohm	1.3Mohm

Sample Application Circuit 4 : FM/AM IF circuit + AM converter
FM IF : 4 stages

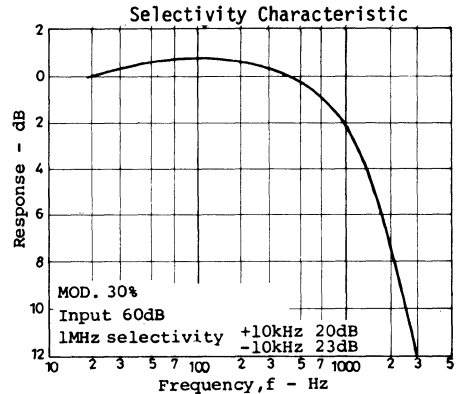
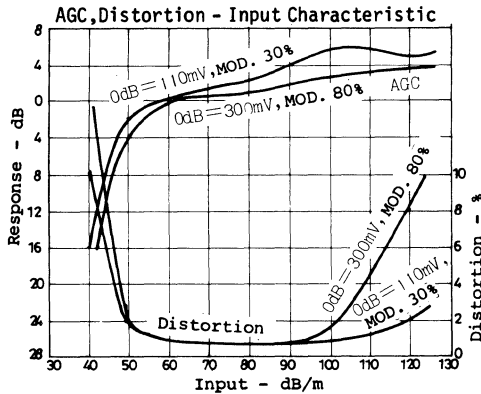
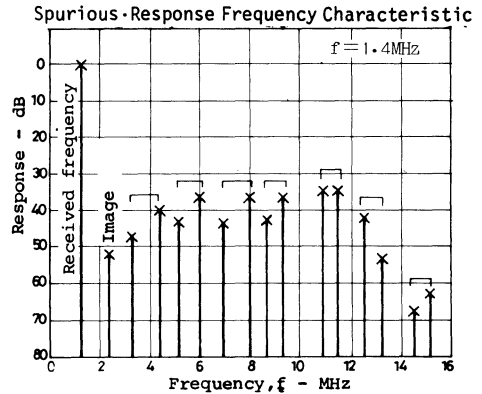
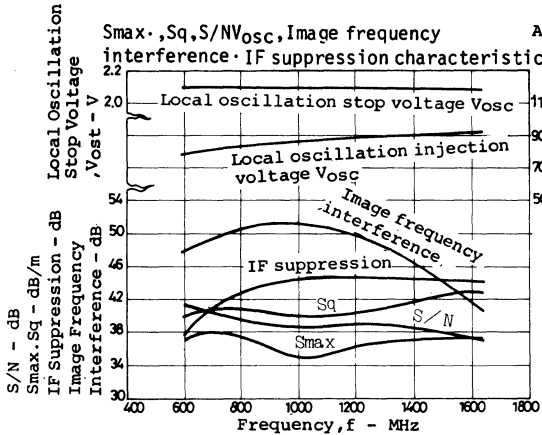


AM Characteristic

Table of Receiver Test Results

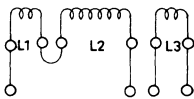
Test Item	Test Condition	Test Frequency	IF : 2 Stages	
Maximum Sensitivity dB/m	Detection output 100mV	600 kHz 1000 kHz 1400 kHz	37 dB/m 36 dB/m 35 dB/m	
Usable Sensitivity dB/m	S/N=20dB	600 kHz 1000 kHz 1400 kHz	40 dB/m 40.5 dB/m 41.5 dB/m	
S/N (dB)	Input 60dB/m		41.0 dB 39.0 dB 39.0 dB	
Distortion (%)	Input=60dB/m Input=126dB/m		1.4%(Mod.30%) 3.5%(Mod.30%)	25%(Mod.80%) 10%(Mod.80%)
Selectivity (dB)	Input=36dB/m	1000 kHz ±10 kHz	20 dB 23 dB	
AGC-FOM	Difference between input=126dB/m and in- put for output of 10dB down	78 dB		
Image frequency in- terference (dB)	Maximum Sensitivity	1400 kHz	46 dB	
IF Interference (dB)	Maximum Sensitivity	600 kHz	38 dB	
Local Oscillation Stop Voltage (V)		600 kHz 1000 kHz 1400 kHz	2.1 V 2.1 V 2.1 V	

Test Item	Test Condition	Test Frequency	IF : 2 Stages	
Local Oscillation Voltage (mV)		600 kHz	78 mV	
		1000 kHz	85 mV	
		1400 kHz	90 mV	

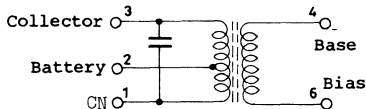


Transformer Specifications

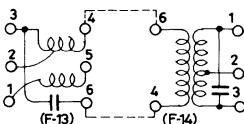
AM bar antenna



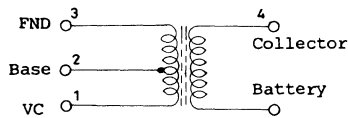
Core 180 x 10ø (blue)
Wire material 10/0.08 (USSC)
Lead wire 10/0.12 (PVC)
L1 solenoid 40turns
L2 space 73turns
L3 solenoid 9turns
Inductance 60uH±5% or more variable
No-load Q 160min/796kHz
Variable capacitor 5 to 131pF (both ANT and OSC)



	Qo	1 to 3	2 to 3	4 to 6	Tuning capacitance
F-11 (black)	80	15turns	4turns	1turns	40pF
F-12 (purple)	80	15	4	1	40
F-21 (orange)	70±15%	7	3	1	180±20
F-22 (orange)	70±15%	7	3	1	180±20
F-23 (orange)	70±15%	7	3	1	180±20
A-11 (yellow)	70	116	28	7	200
A-12 (white)	100	116	28	9	200
A-13 (black)	100	144	-	101	200

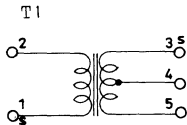
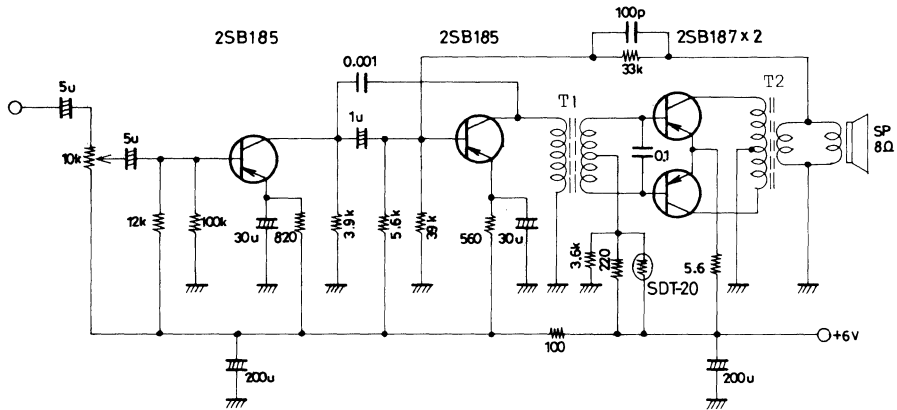


F-13 (pink) 2 to 3 5turns, 2 to 4 12 1/2 turns, 1 to 4 4 1/2 turns
F-14 (blue) 1 to 2 7turns, 2 to 3 7turns, 4 to 6 1 1/2 turns
Tuning capacitance : 50pF, Qo=105±25%

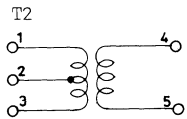


A-14 (red) 1 to 3 96turns, 2 to 3 2turns, 4 to 5 5turns
 Inductance $360\mu\text{H} \pm 8\%$
 Q_0 $100 \pm 20\% / 796\text{kHz}$

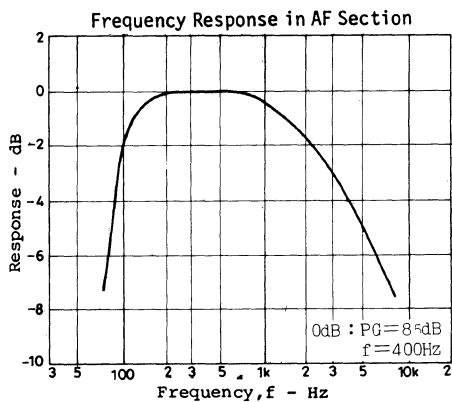
Audio frequency circuit used in test



Turn ratio 1 - 2 : 3 - 5 = 2k : 1k
 DC resistance 1 - 2 140 to 185 ohm
 3 - 5 85 to 113 ohm



Turn ratio 1 - 3 : 4 - 5 = 150 ohm : 8 ohm
 DC resistance 1 - 3 $11.6\text{ohm} \pm 15\%$
 4 - 5 $0.81\text{ohm} \pm 15\%$



2SC1570, 1571, 1571L



2003A

NPN Epitaxial Planar
Silicon Transistors

Very Low Noise Amp Applications

Ⓔ431C

. The 2SC1570, 1571, 1571L are developed as very low-noise transistors and are especially suited for use in equalizer first stage of high-grade type stereo sets.

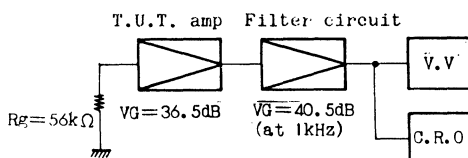
Absolute Maximum Ratings at Ta=25°C		2SC1570	2SC1571	2SC1571L	unit
Collector to Base Voltage	V_{CB0}	55	40	40	V
Collector to Emitter Voltage	V_{CE0}	50	35	35	V
Emitter to Base Voltage	V_{EB0}		5		V
Collector Current	I_C		100		mA
Allowable Power Dissipation	P_C		200		mW
Junction Temperature	T_j		125		°C
Storage Temperature	T_{stg}		-55 to +150		°C

Electrical Characteristics at Ta=25°C		min	typ	max	unit
Collector Cutoff Current	I_{CB0} $V_{CB}=18V, I_E=0$			0.1	uA
Emitter Cutoff Current	I_{EB0} $V_{EB}=3V, I_C=0$			0.1	uA
DC Current Gain	h_{FE}^* $V_{CE}=6V, I_C=1mA$	160*		960*	
Gain Bandwidth Product	f_T $V_{CE}=6V, I_C=1mA$		100		MHz
Output Capacitance	c_{ob} $V_{CB}=6V, f=1MHz$		3		pF
C-E Saturation Voltage	$V_{CE(sat)}$ $I_C=50mA, I_B=5mA$			0.5	V
Base to Emitter Voltage	V_{BE} $V_{CE}=2V, I_C=1mA$	0.58	0.80		V
C-B Breakdown Voltage	$V_{(BR)CBO}$ $I_C=10uA, I_B=0$		[C1570] 55		V
			[C1571, 1571L] 40		V
C-E Breakdown Voltage	$V_{(BR)CEO}$ $I_C=1mA, R_{BF}=\infty$		[C1570] 50		V
			[C1571, 1571L] 35		V
E-B Breakdown Voltage	$V_{(BR)EBO}$ $I_E=10uA, I_C=0$		5		V
Noise Voltage	at test circuit [C1570, 1571]			40	mV
	$V_{CC}=30V, I_C=1mA$ [C1571L]			65	mV
	$R_g=56k\Omega, V_G=77dB$ (at 1kHz)				
Noise Peak Level	" " [C1570, 1571]			280	mV
	" " [C1571L]			450	mV

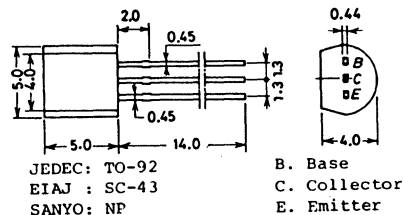
* The 2SC1570, 1571, 1571L are classified by 1mA h_{FE} as follows:

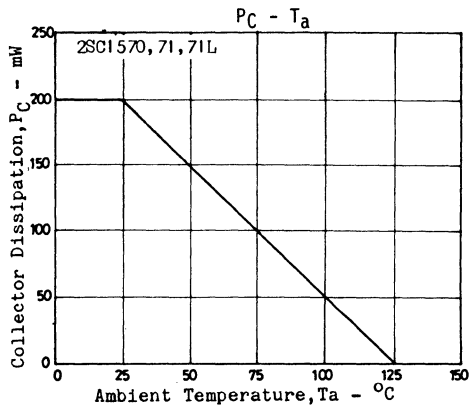
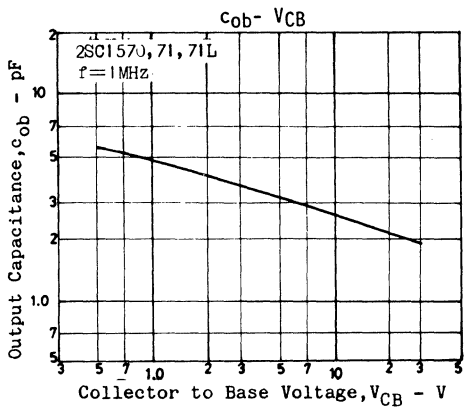
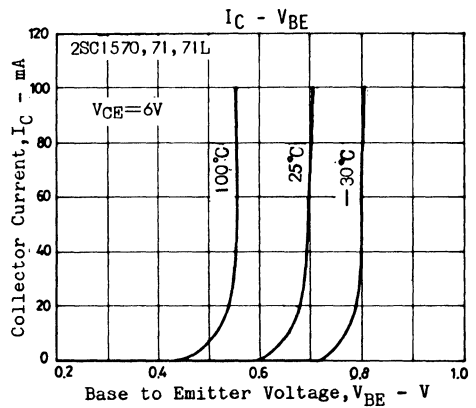
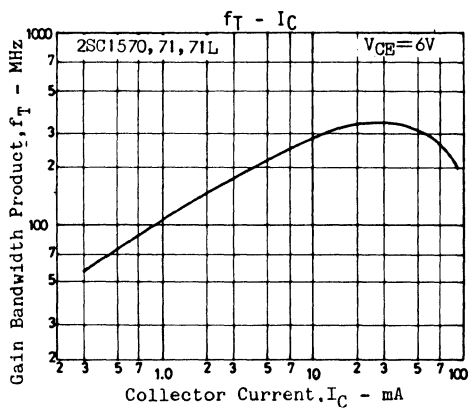
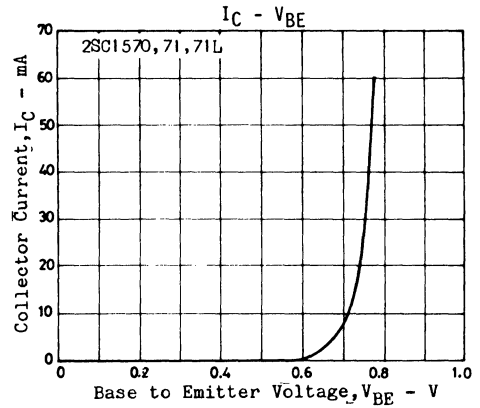
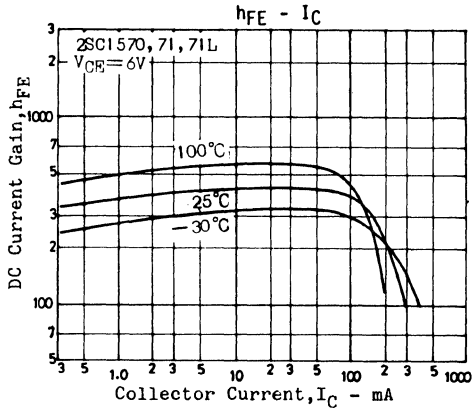
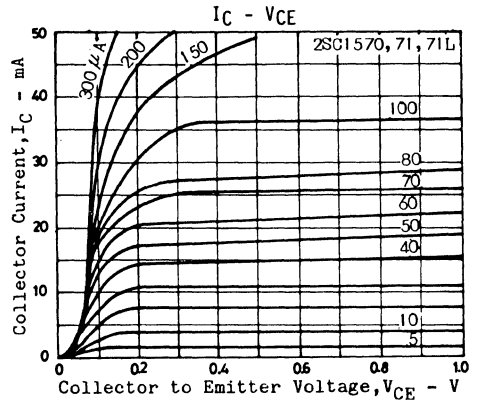
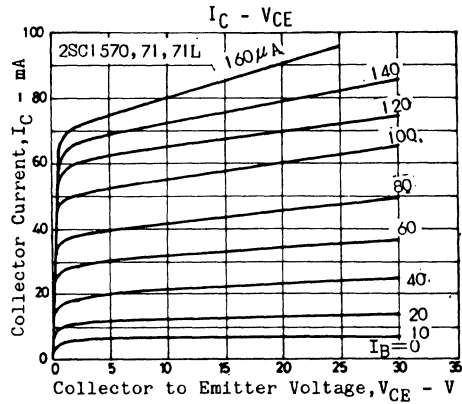
160	F	320	280	G	560	480	H	960
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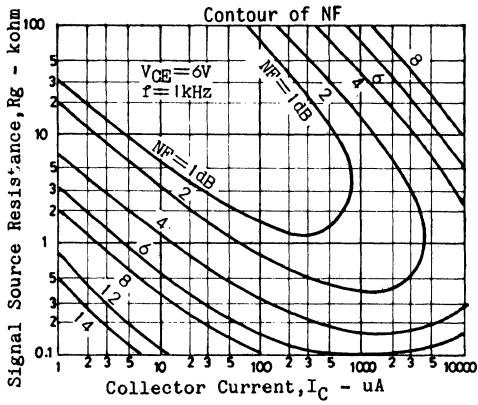
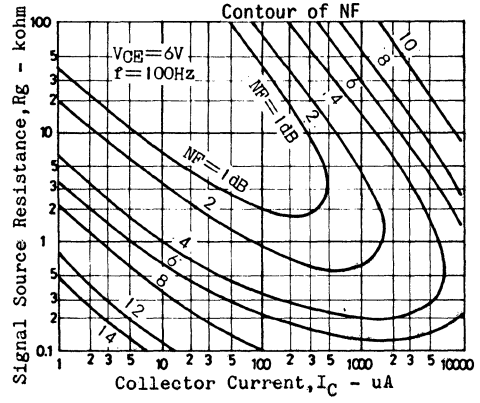
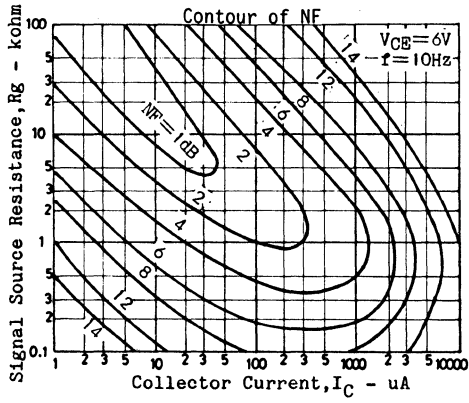
Noise Test Circuit



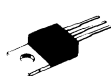
Case Outline 2003A (unit:mm)







2SC1755, 1756, 1757



2010A



2013



2012

PNP Triple Diffused Planar
Silicon Transistors

TV Chroma Output, Video Output, Sound Output Applications

©429C

These 2SC1755,1756,1757 are different only from their packages.

Absolute Maximum Ratings at Ta=25°C

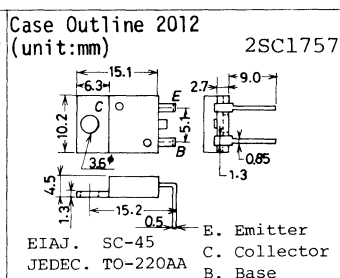
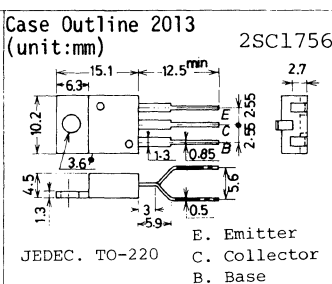
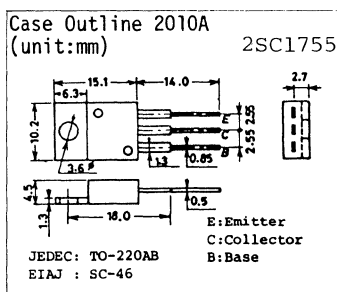
Absolute Maximum Ratings at Ta=25°C			unit
Collector to Base Voltage	V _{CB0}	300	V
Collector to Emitter Voltage	V _{CEO}	300	V
Emitter to Base Voltage	V _{EBO}	7	V
Collector Current	I _C	200	mA
Peak Collector Current	i _{cp}	700	mA
Collector Dissipation	P _C	Ta=25°C	1.2 W
	P _C	Tc=25°C	15 W
Junction Temperature	T _j	150	°C
Storage Temperature	T _{stg}	-40 to +150	°C

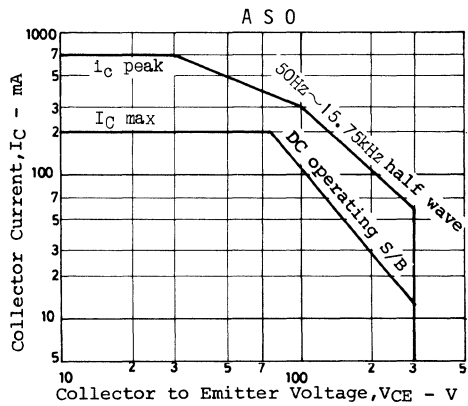
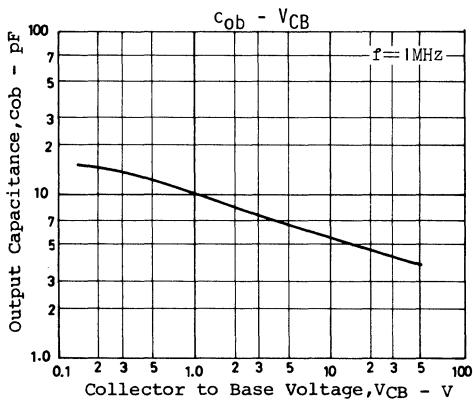
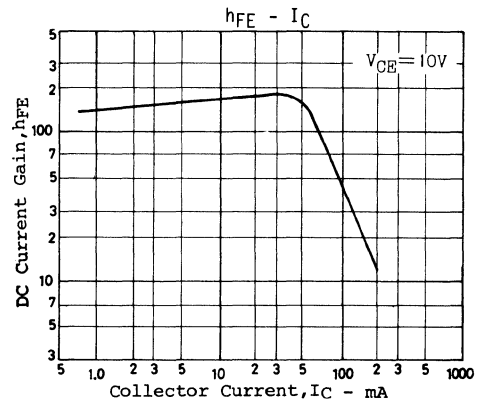
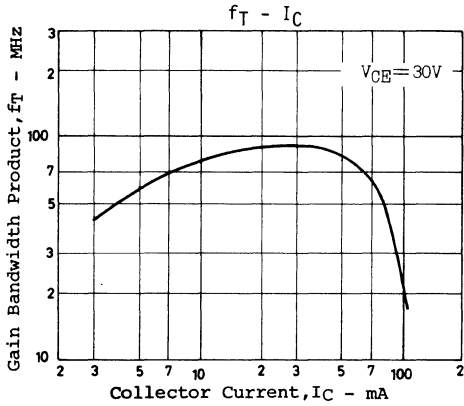
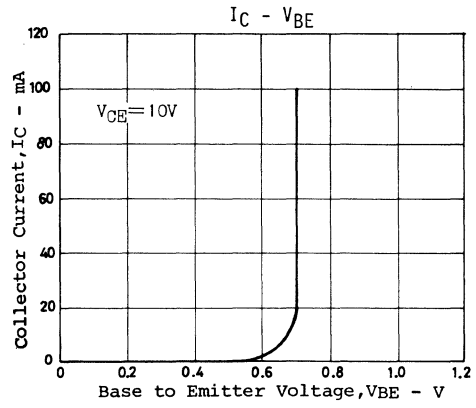
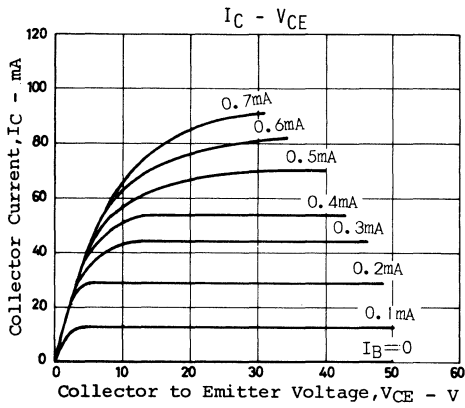
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I _{CBO}	V _{CB} =200V, I _E =0			0.1	uA
Emitter Cutoff Current	I _{EBO}	V _{EB} =5V, I _C =0			0.1	uA
DC Current Gain	h _{FE}	V _{CE} =10V, I _C =10mA	40*		200*	
Gain Bandwidth Product	f _T	V _{CE} =30V, I _C =10mA	50			MHz
Output Capacitance	c _{ob}	V _{CB} =50V, f=1MHz			5.3	pF
C-E Saturation Voltage	V _{CE(sat)}	I _C =50mA, I _B =5mA			2.0	V

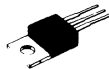
* The 2SC1755,1756, 1757 are classified as follows.

40	C	80	60	D	120	100	E	200
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2SC2078



2010A

NPN Epitaxial Planar
Silicon Transistor

27MHz High Frequency Power Amp Applications

Ⓔ462C

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

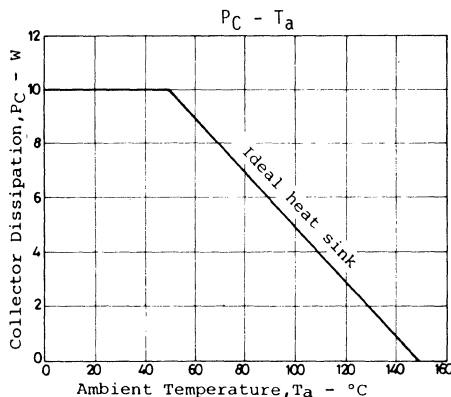
			unit
Collector to Base Voltage	V_{CBO}	80	V
Collector to Emitter Voltage	V_{CER}	75	V
Emitter to Base Voltage	V_{EBO}	5	V
Collector Current	I_C	3	A
Peak Collector Current	i_{cp}	5	A
Collector Dissipation	P_C	1.2	W
		10	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics Characteristics at $T_a=25^{\circ}\text{C}$

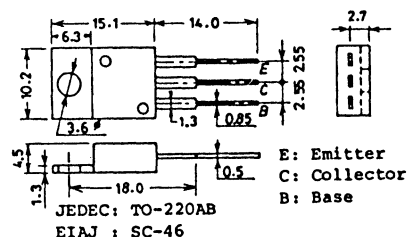
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=40\text{V}, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4\text{V}, I_C=0$			10	μA
DC Current Gain	h_{FE}	$V_{CE}=5\text{V}, I_C=0.5\text{A}$	25*		200*	
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=0.1\text{A}$	100	150		MHz
Output Capacitance	c_{ob}	$V_{CB}=10\text{V}, f=1\text{MHz}$		45	60	pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=1\text{A}, I_B=0.1\text{A}$		0.15	0.6	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=1\text{A}, I_B=0.1\text{A}$		0.9	1.2	V
C-B Saturation Voltage	$V_{(BR)CBO}$	$I_C=100\mu\text{A}, I_B=0$	80			V
C-E Saturation Voltage	$V_{(BR)CER}$	$I_C=1\text{mA}, R_{BE}=150\text{ohm}$	75			V
E-B Saturation Voltage	$V_{(BR)EBO}$	$I_E=100\mu\text{A}, I_C=0$	5			V
[At specified test circuit]						
Output Power	P_o	$V_{CC}=12\text{V}, f=27\text{MHz}, P_i=0.2\text{W}$	4.0			W
Power Efficiency	η		60			%

* The 2SC2078 is classified by 0.5A h_{FE} as follows:

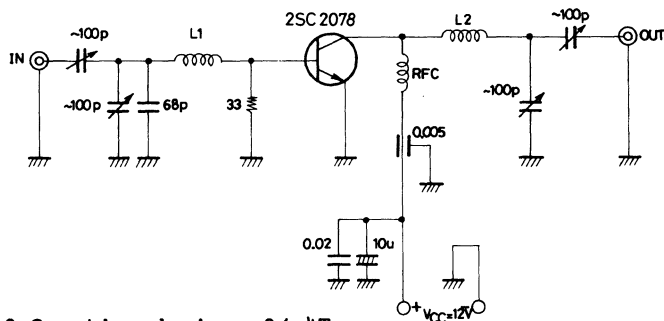
25	B	50	40	C	80	60	D	120	100	E	200
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Case Outline 2010A (unit:mm)

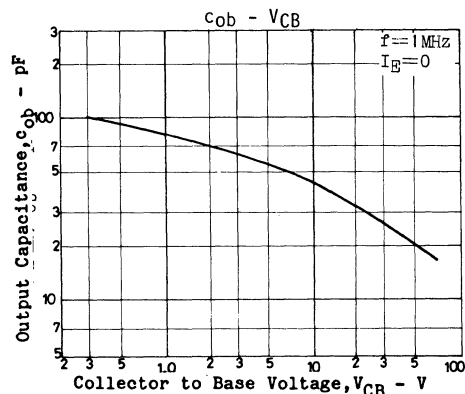
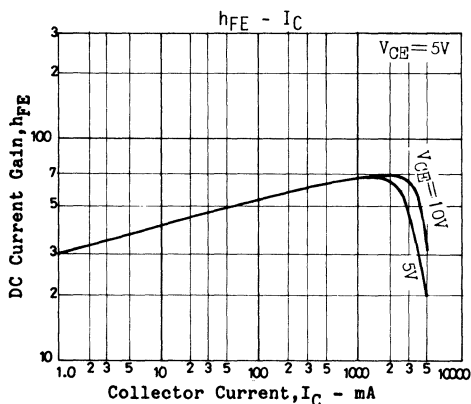
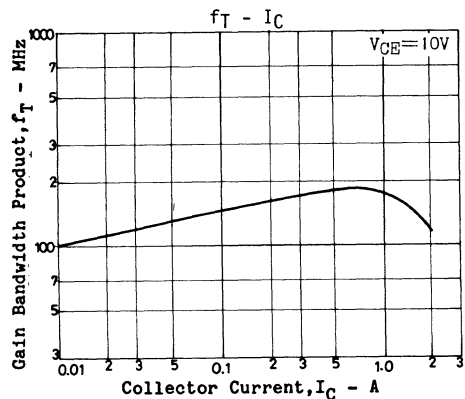
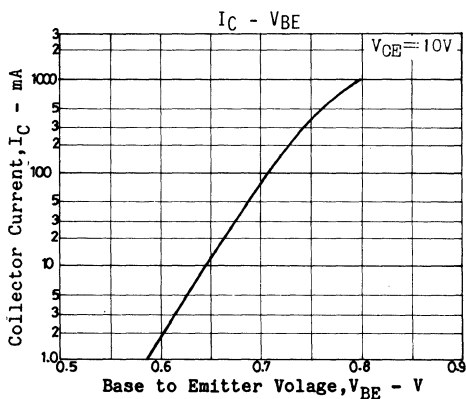
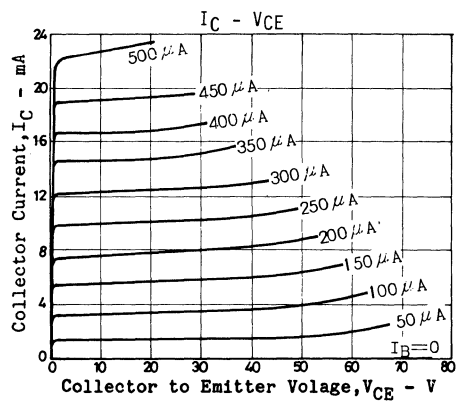
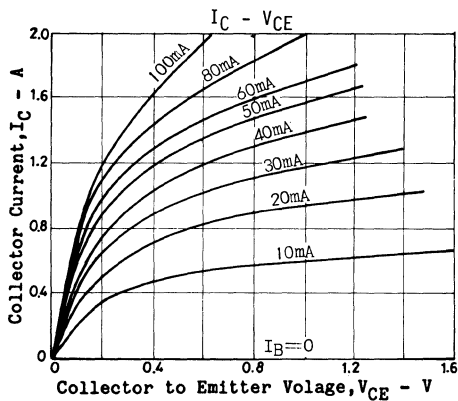


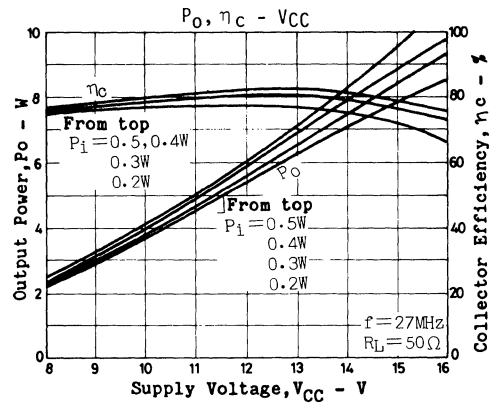
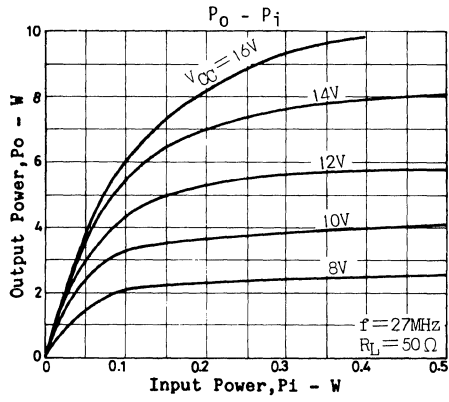
2SC2078 27MHz Output Power Test Circuit

Coil data L1: 0.3mm tinned wire, 9 ϕ 4TL2: 0.6mm tinned wire, 9 ϕ 4T

RFC

2.2uH





2SC2210



2003A

NPN Epitaxial Planar
Silicon Transistor

AM RF Amp, Converter Applications

©374E

Features

- . Highly resistant to dielectric breakdown and suited for car use.
- . Good spurious characteristic due to low f_T .
- . Small noise figure.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	30	V
Collector to Emitter Voltage	V_{CEO}	20	V
Emitter to Base Voltage	V_{EBO}	5	V
Collector Current	I_C	30	mA
Collector Dissipation	P_C	250	mW
Junction Temperature	T_J	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +125	$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

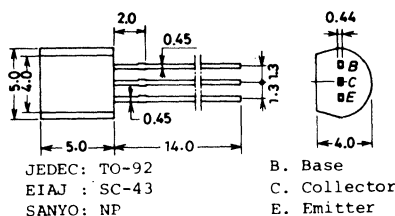
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=10\text{V}, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4\text{V}, I_C=0$			0.1	μA
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu\text{A}, I_E=0$	30			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1\text{mA}, R_{BE}=\infty$	20			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu\text{A}, I_C=0$	5			V
DC Current Gain	h_{FE}	$V_{CE}=6\text{V}, I_C=1\text{mA}$	40		320	
Gain Bandwidth Product	f_T	$V_{CE}=6\text{V}, I_C=1\text{mA}$	50	90	170	MHz
Reverse Transfer Capacitance	c_{re}	$V_{CE}=6\text{V}, f=1\text{MHz}$		3.5	4.5	pF
C-B Time Constant	r_{bb}, C_c	$V_{CE}=6\text{V}, I_C=1\text{mA}, f=31.9\text{MHz}$		25	50	ps
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=10\text{mA}, I_B=1\text{mA}$			0.4	V
Noise Figure	NF	$V_{CE}=10\text{V}, I_C=0.5\text{mA}, f=455\text{kHz}, R_g=1\text{kohm}$		2.0		dB

* The 2SC2210 is classified by 1mA h_{FE} as follows:

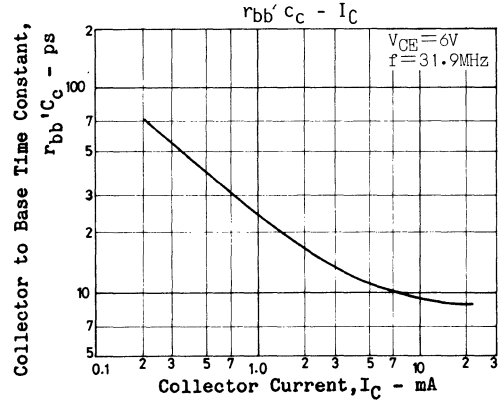
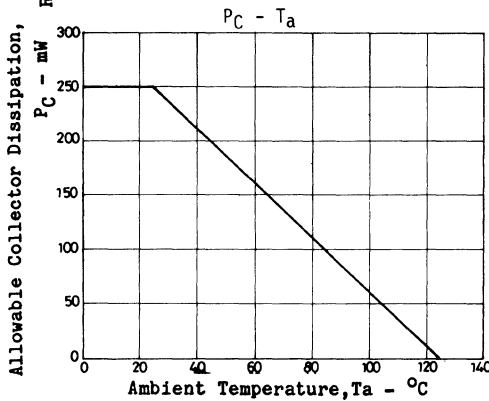
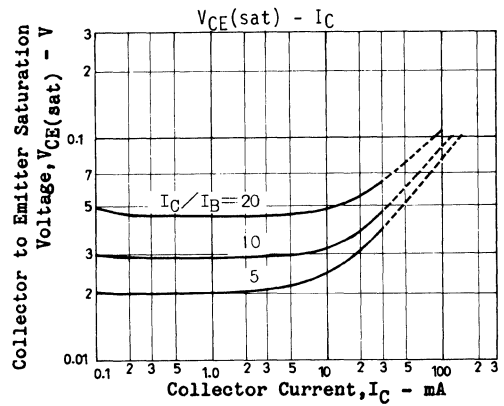
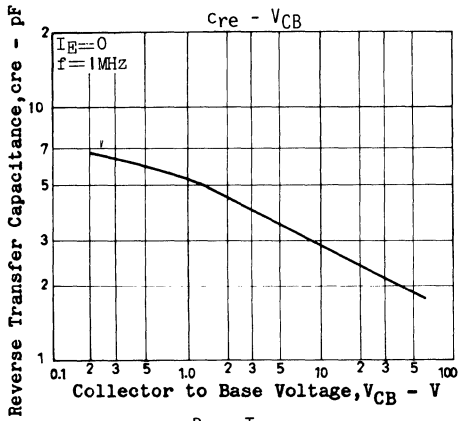
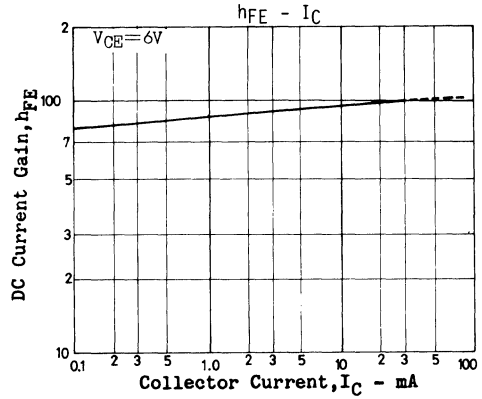
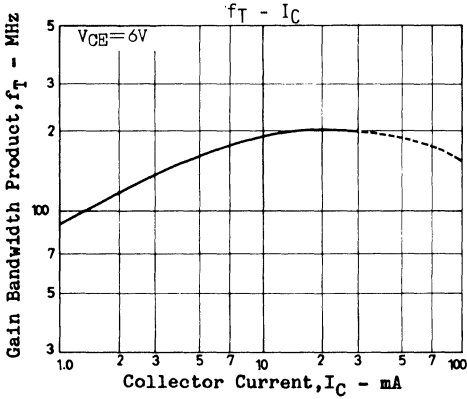
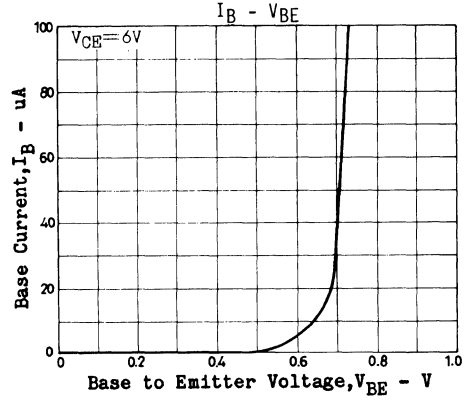
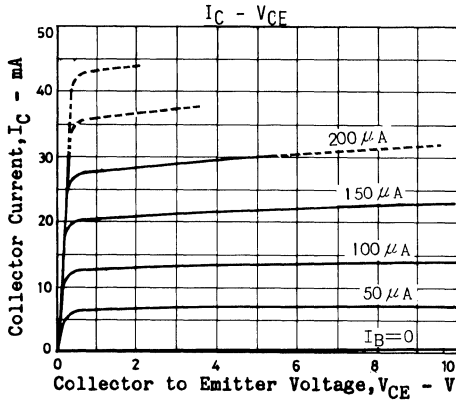
40	C	80	60	D	120	100	E	200	160	F	320
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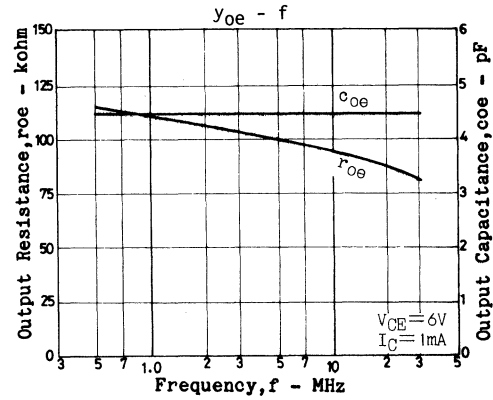
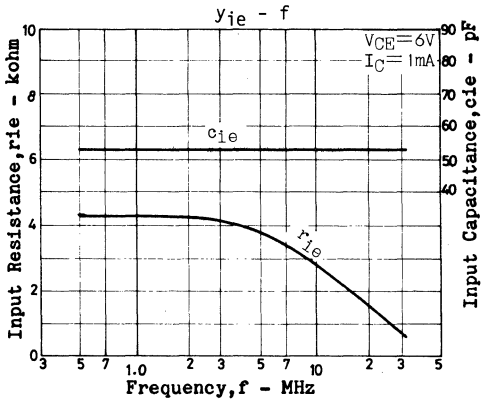
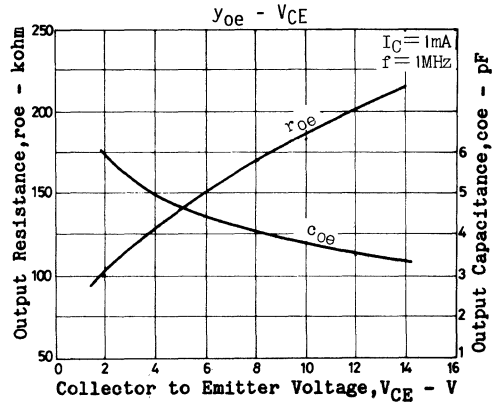
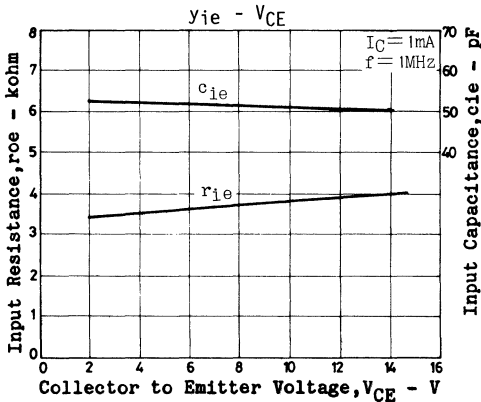
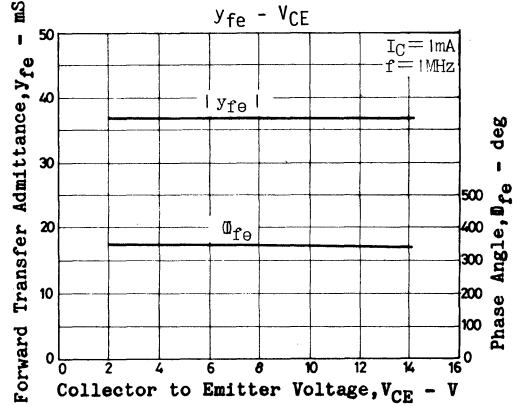
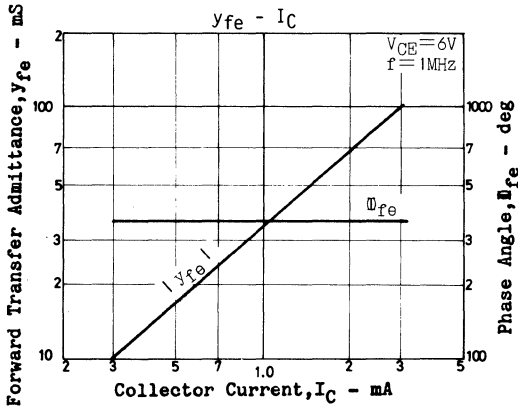
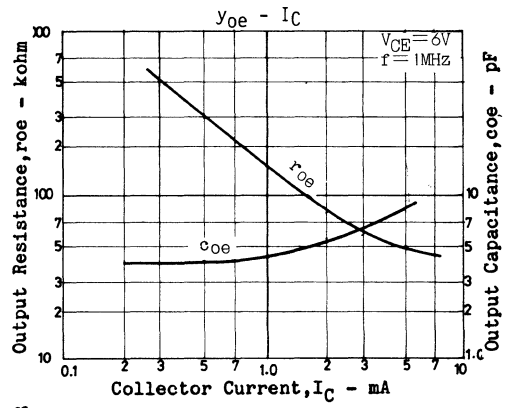
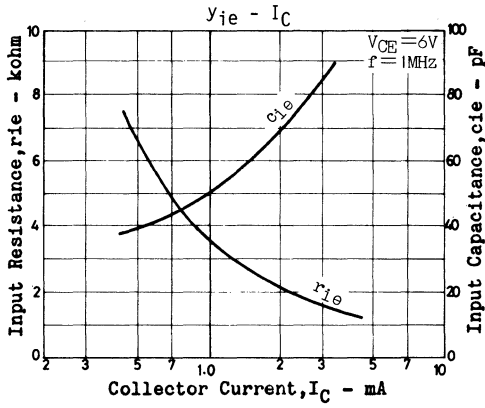
Case Outline 2003A

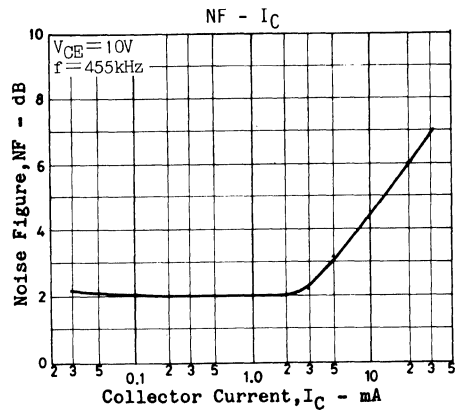
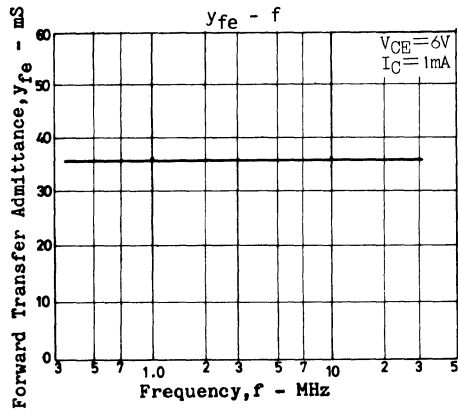
(unit:mm)



3145MY, TS No. 374-1/4









2006A

NPN Triple Diffused Planar Silicon Transistors

TV Video Output Applications

(E)665B

The 2SC2228A is designed for color TV chroma output use; and the 2SC2228Y is designed for B/W TV video output use.

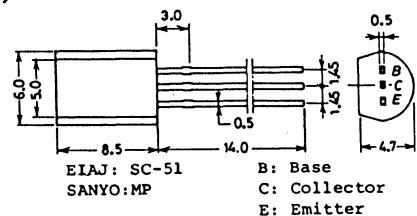
Absolute Maximum Ratings at Ta=25°C		2SC2228A	2SC2228Y	unit
Collector to Base Voltage	V _{CBO}	200	160	V
Collector to Emitter Voltage	V _{CEO}	200	160	V
Emitter to Base Voltage	V _{EBO}		5	V
Collector Current	I _C		50	mA
Peak Collector Current	i _{cp}		100	mA
Collector Dissipation	P _C		900	mW
Junction Temperature	T _J		150	°C
Storage Temperature	T _{stg}	-55 to +150		°C

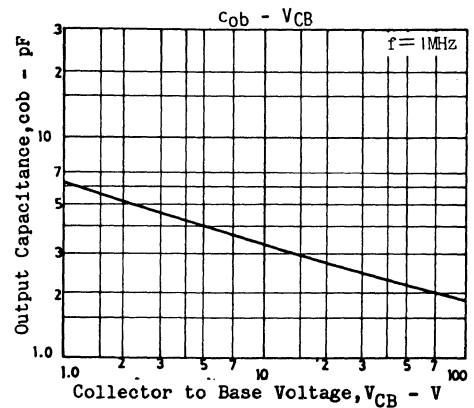
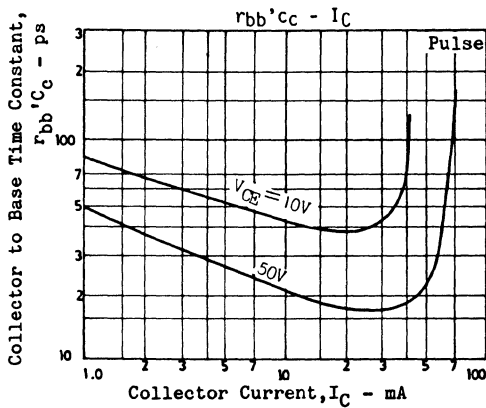
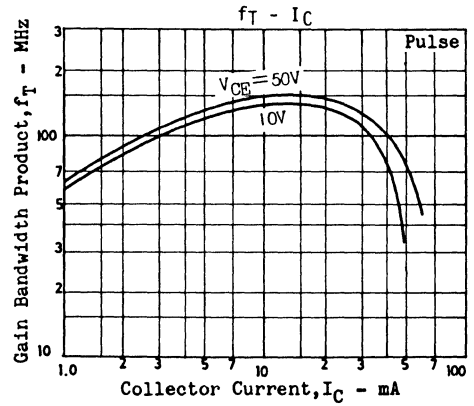
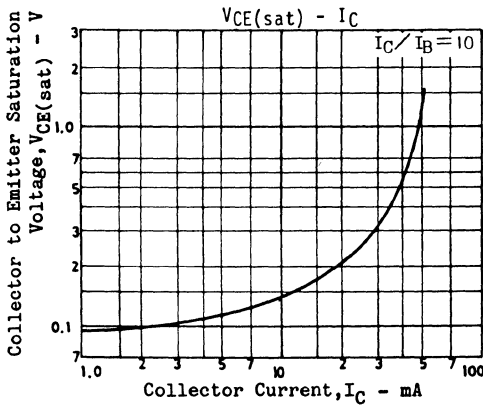
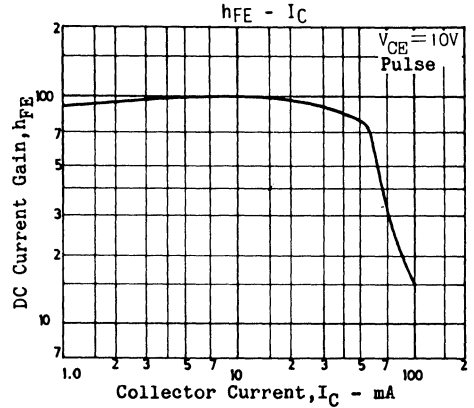
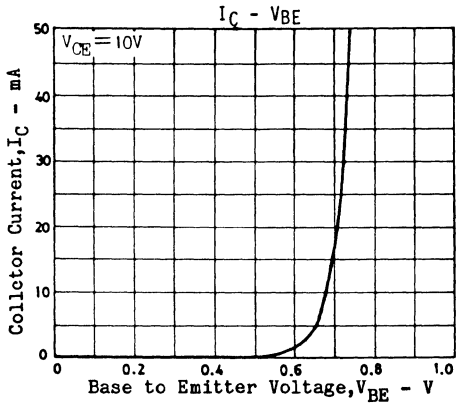
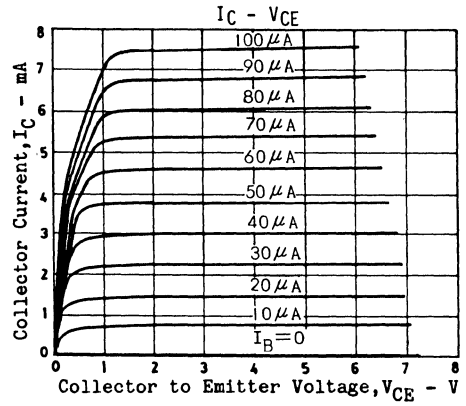
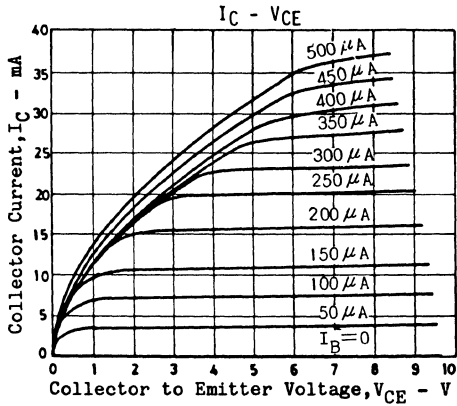
Electrical Characteristics at Ta=25°C			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=200V, I_E=0$ [2SC2228A] $V_{CB}=160V, I_E=0$ [2SC2228Y]			1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			1.0	μA
DC Current Gain	h_{FE}^*	$V_{CE}=10V, I_C=10mA$	40*		320*	
Gain Bandwidth Product	f_T	$V_{CE}=30V, I_C=10mA$	50			MHz
Output Capacitance	c_{ob}	$V_{CB}=10V, f=1MHz$			4.0	pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=20mA, I_B=2mA$			0.6	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=20mA, I_B=2mA$			1.0	V

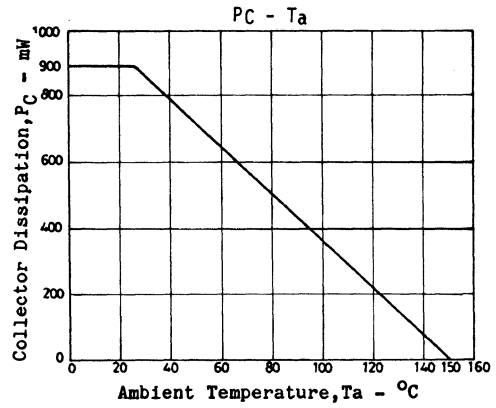
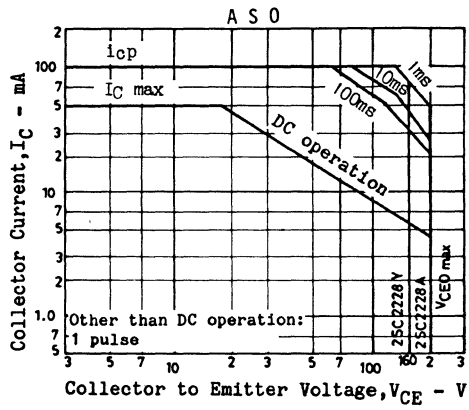
* The 2SC2228A is usable in C, D, E ranks and the 2SC2228Y is usable in C, D, E, F ranks which are classified by 10mA h_{FE} as follows:

40	C	80	60	D	120	100	E	200	160	F	320
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Case Outline 2006A
(unit:mm)







2SC2271



2006A

NPN Triple Diffused Planar
Silicon Transistor

Chroma Output, Horizontal Deflection Driver Applications

E493D

Small-sized color TV chroma use and B/W TV, color TV horizontal deflection driver use.

Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V _{CB0}	300	V
Collector to Emitter Voltage	V _{CE0}	300	V
Emitter to Base Voltage	V _{EB0}	6	V
Collector Current	I _C	100	mA
Peak Collector Current	i _{cp}	300	mA
Collector Dissipation	P _C	900	mW
Junction Temperature	T _j	150	°C
Storage Temperature	T _{stg}	-55 to +150	°C

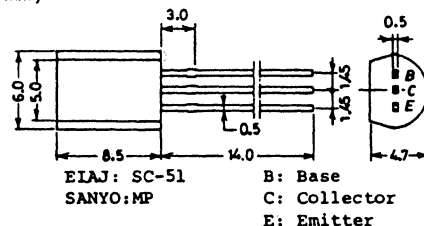
Electrical Characteristics at Ta=25°C

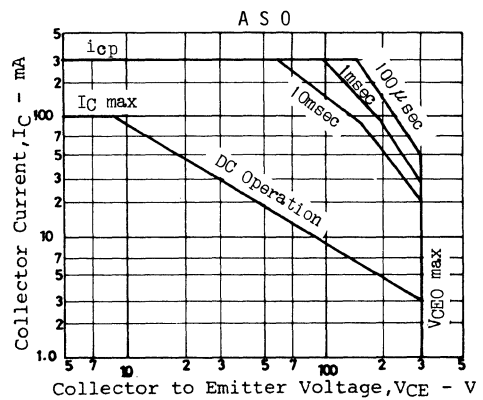
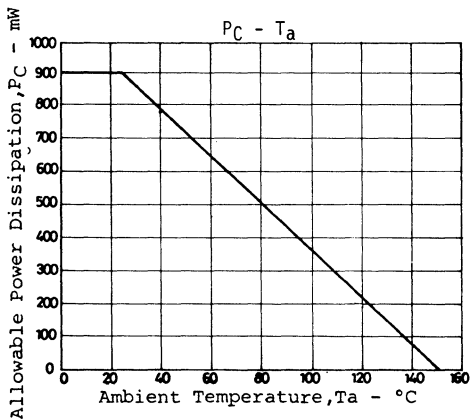
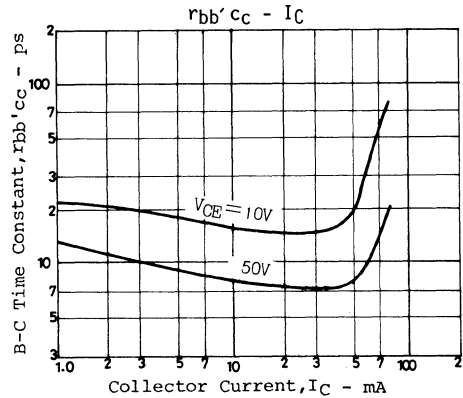
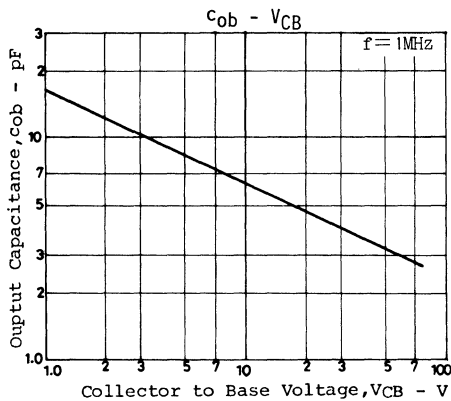
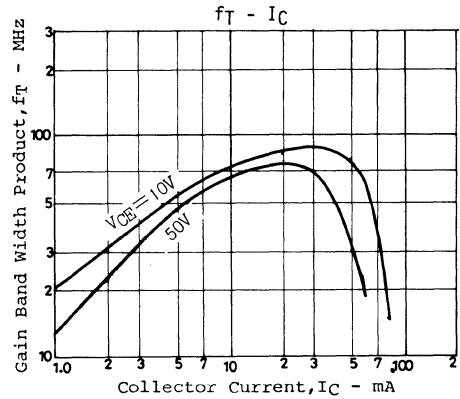
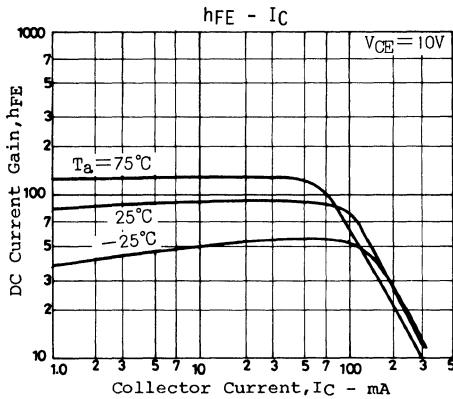
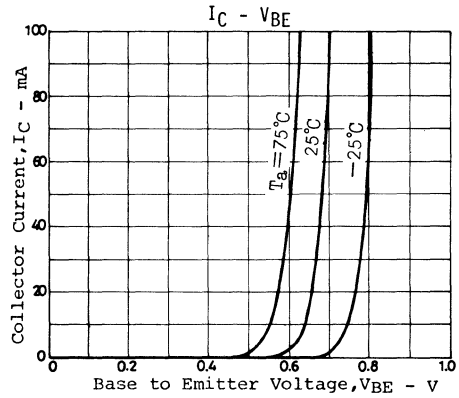
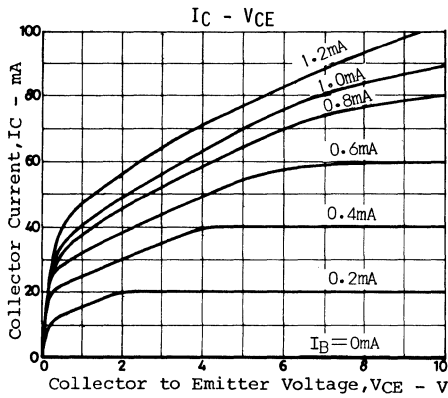
		min	typ	max	unit
Collector Cut Off Current	I _{CBO} V _{CB} =200V, I _E =0			1.0	uA
Emitter Cut Off Current	I _{EBO} V _{EB} =6V, I _C =0			1.0	uA
DC Current Gain	h _{FE} V _{CE} =10V, I _C =10mA	40*		200*	
Gain Band Width Product	f _T V _{CE} =30V, I _C =10mA	50			MHz
Output Capacitance	c _{ob} V _{CB} =10V, f=1MHz			7.5	pF
C-E Saturation Voltage	V _{CE(sat)} I _C =20mA, I _B =2mA			0.6	V
B-E Saturation Voltage	V _{BE(sat)}			1.0	V

* The 2SC2271 is classified by 10mA h_{FE} as follows.

40	C	80	60	D	120	100	E	200
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Case Outline 2006A (unit:mm)





2SC2274, 2274K



2003A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA984, 984K

Low Frequency Power Amp Applications

©465E

Features

- High breakdown voltage ($V_{CE0} \geq 50/80V$).
- High current ($I_C = 500mA$).
- Low saturation voltage.

(): 2SA984, 984K

Absolute Maximum Ratings at $T_a = 25^\circ C$

		A984, C2274	A984K, C2274K	unit
Collector to Base Voltage	V_{CBO}	(-) 60	(-) 100	V
Collector to Emitter Voltage	V_{CEO}	(-) 50	(-) 80	V
Emitter to Base Voltage	V_{EBO}		(-) 5	V
Collector Current	I_C	(-) 500		mA
	i_{cp}	(-) 800		mA
Collector Dissipation	PC		600	mW
Junction Temperature	T_j		150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150		$^\circ C$

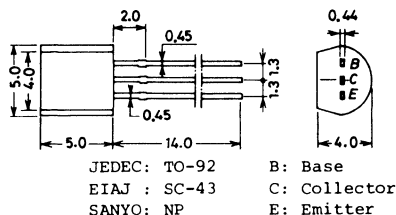
Electrical characteristics at $T_a = 25^\circ C$

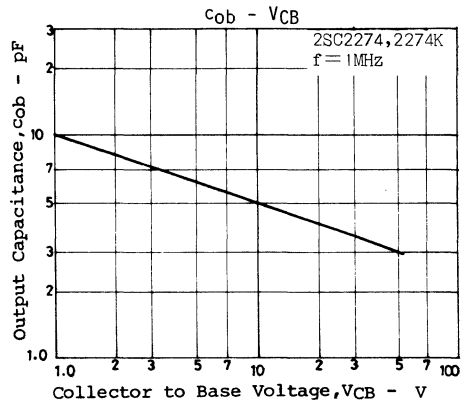
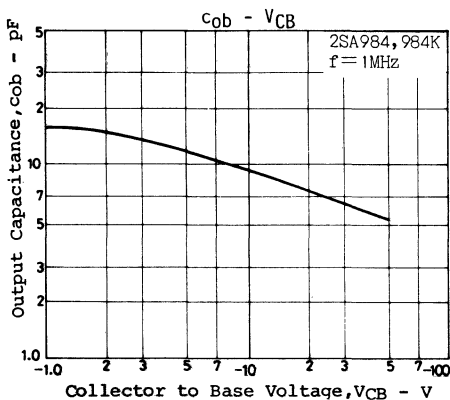
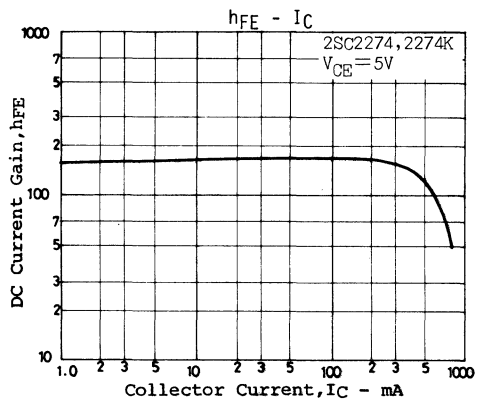
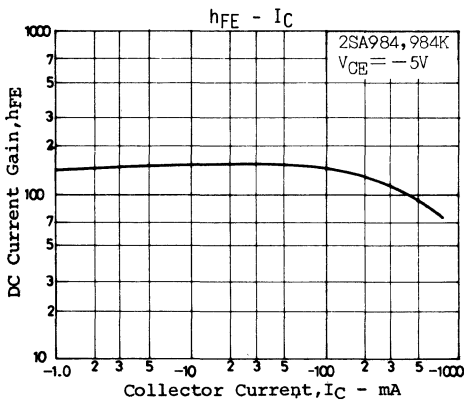
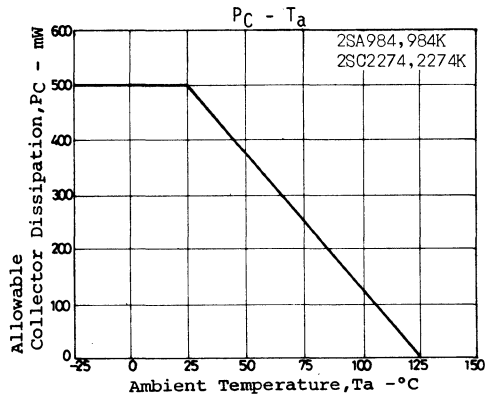
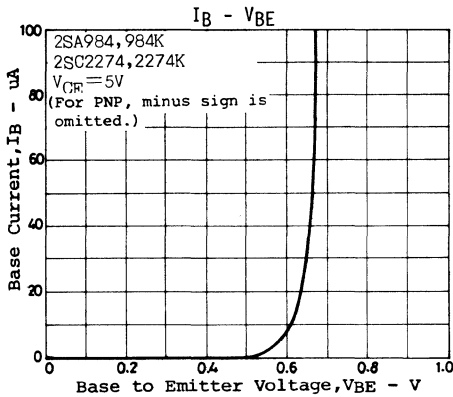
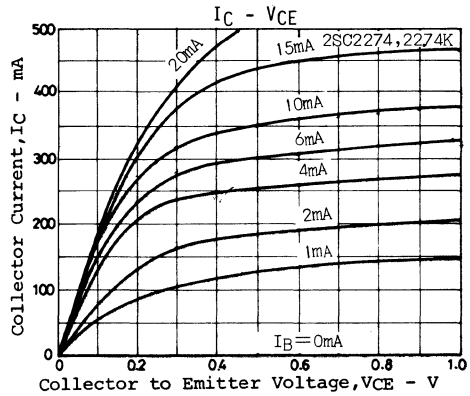
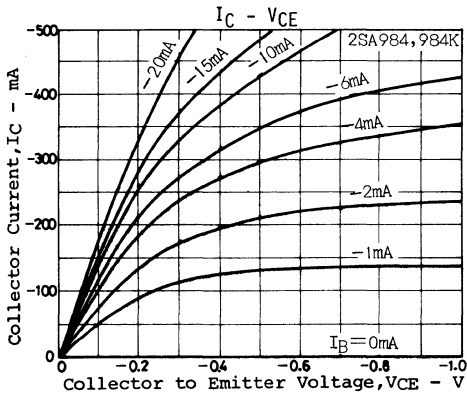
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-) 40V, I_E = 0$			(-) 1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-) 4V, I_C = 0$			(-) 1.0	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = (-) 5V, I_C = (-) 50mA$	60*		320*	
	$h_{FE}(2)$	$V_{CE} = (-) 5V, I_C = (-) 400mA, \text{pulse}$	35			
G-B Product	f_T	$V_{CE} = (-) 10V, I_C = (-) 10mA$		120		MHz
Output Capacitance	c_{ob}	$V_{CB} = (-) 10V, f = 1MHz$		(9)		pF
				5		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-) 400mA, I_B = (-) 40mA$		(-0.25)	(-0.6)	V
				0.2	0.6	V
B-E Saturation Voltage	$V_{BE(sat)}$	" "		(-) 0.9	(-) 1.2	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-) 10\mu A, I_E = 0$			A984, C2274 (-) 60	V
					A984K, C2274K (-) 100	V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-) 1mA, R_{BE} = \text{open}$			A984, C2274 (-) 50	V
					A984K, C2274K (-) 80	V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-) 10\mu A, I_C = 0$			(-) 5	V

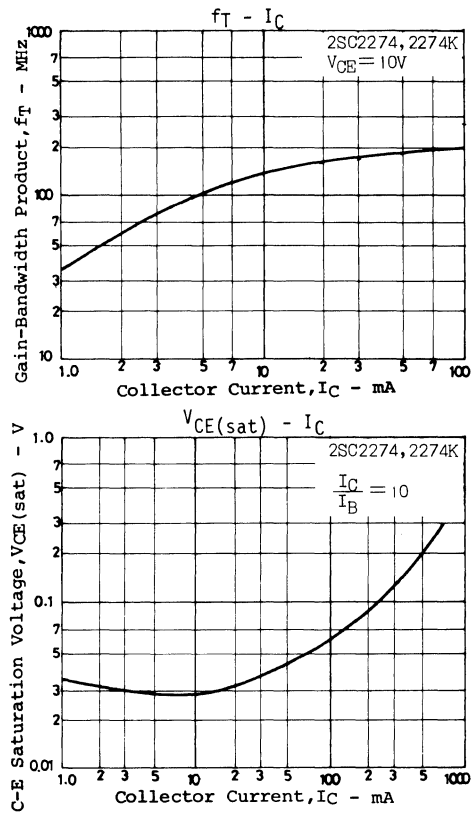
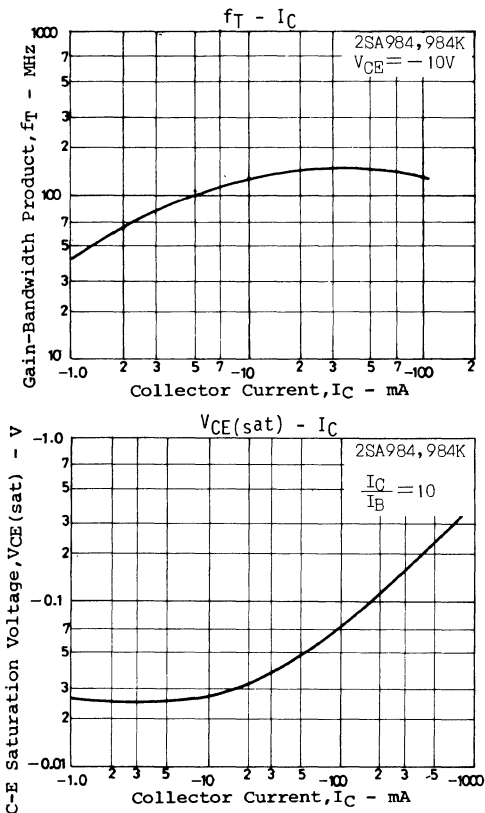
* The 2SA984, K, 2SC2274, K are classified by 50mA h_{FE} as follows.

60	D	120	100	E	200	160	F	320
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Case Outline 2003A (unit:mm)









27MHz CB Transceiver Driver Applications

Ⓔ485D

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

Collector to Base Voltage	V_{CB0}	75	V
Collector to Emitter Voltage	V_{CER}	75	V
Collector to Emitter Voltage	V_{CEO}	45	V
Emitter to Base Voltage	V_{EBO}	5	V
Collector Current	I_C	1.0	A
	i_{cp}	1.5	A
Collector Dissipation	P_C	750	mW
	$T_c=25^{\circ}\text{C}$	5	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

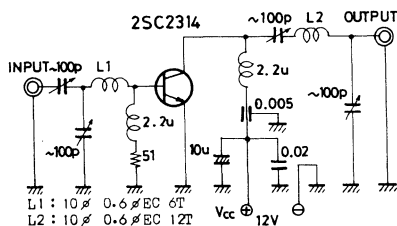
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

		min	typ	max	unit
Collector Cutoff Current	I_{CBO}			1.0	μA
Emitter Cutoff Current	I_{EBO}			1.0	μA
C-B Breakdown Voltage	$V_{(BR)CBO}$	75			V
C-E Breakdown Voltage	$V_{(BR)CER}$	75			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	45			V
E-B Breakdown Voltage	$V_{(BE)EBO}$	5			V
DC Current Gain	h_{FE}^*	60*		320*	
Gain Band-width Product	f_T	180	250		MHz
Output Capacitance	c_{ob}		15	25	pF
Output Power	P_O	1.0	1.8		W
Collector Efficiency	η_c	60			%
C-E Saturation Voltage	$V_{CE(sat)}$		0.2	0.6	V
B-E Saturation Voltage	$V_{BE(sat)}$		0.9	1.2	V

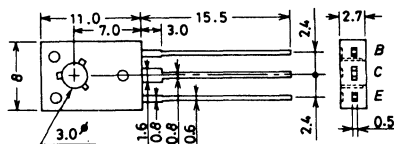
* The 2SC2314 is classified by 500mA h_{FE} as follows:

60	D	120	100	E	200	160	F	320
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Collector Efficiency Test Circuit

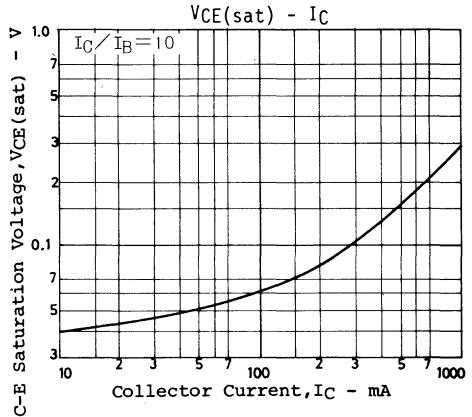
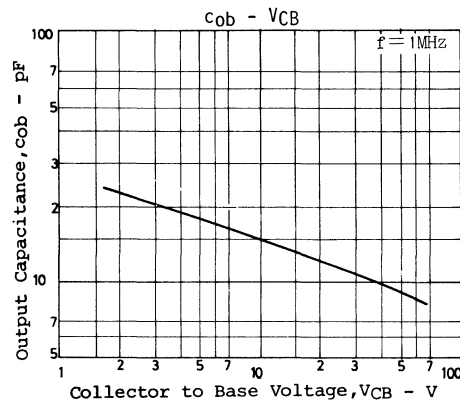
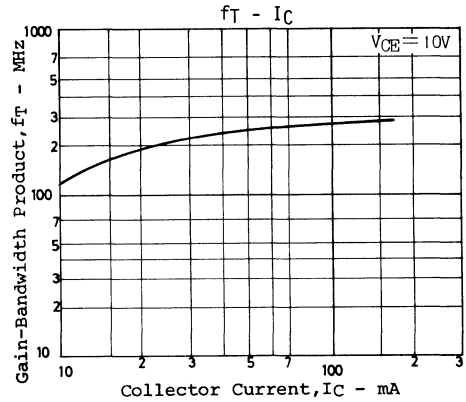
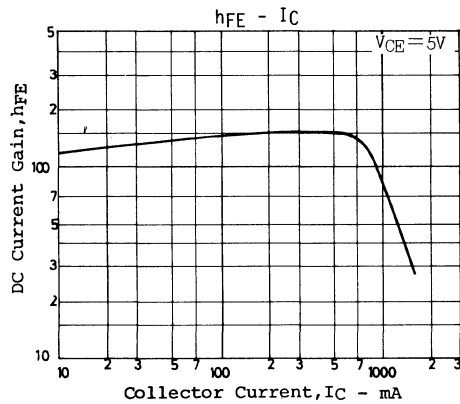
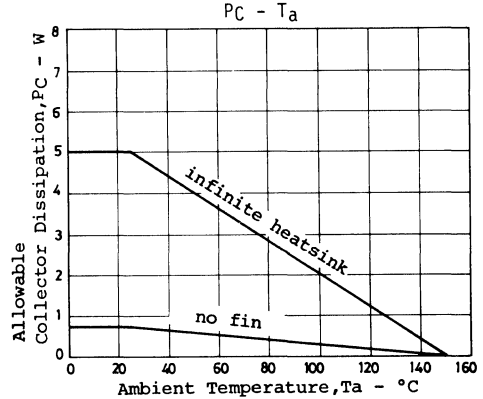
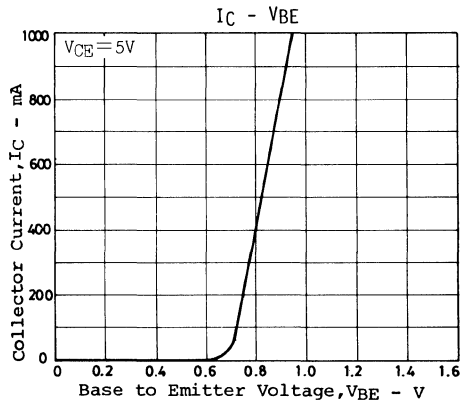
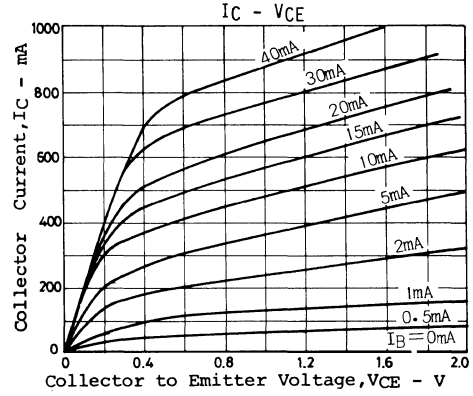
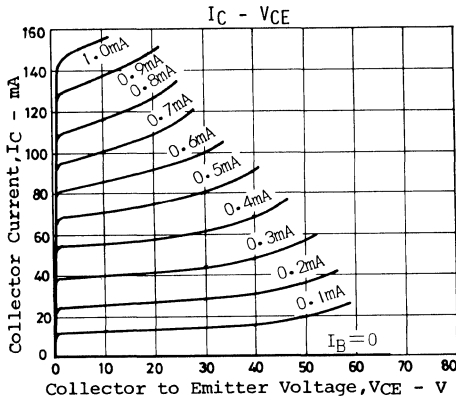


Case Outline 2009 (unit:mm)

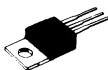


JEDEC: TO-126

B: Base
C: Collector
E: Emitter



2SC2344



2010A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1011

High Voltage Switching, AF 100W Predriver Applications

©544D

(): 2SA1011

Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CBO}	(-)180	V
Collector to Emitter Voltage	V_{CEO}	(-)160	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)1.5	A
Peak Collector Current	i_{cp}	(-)3	A
Collector Dissipation	P_C	25	W
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

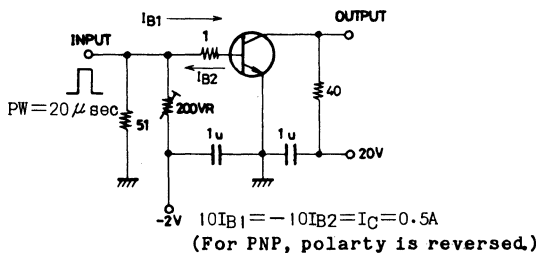
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)120V, I_E=0$			(-)10	uA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$			(-)10	uA
DC Current Gain	h_{FE}	$V_{CE}=(-)5V, I_C=(-)300mA$	60*		200*	
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		100		MHz
Output Capacitance	C_{ob}	$V_{CB}=(-)10V, f=1MHz$		(30)		pF
				23		pF
Base to Emitter Voltage	V_{BE}	$V_{CE}=(-)5V, I_C=(-)10mA$			(-)1.5	V
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500mA, I_B=(-)50mA$		(-0.5)		V
				0.3		V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)1mA, I_E=0$	(-)180			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, I_{BE}=\infty$	(-)160			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)1mA, I_C=0$	(-)6			V
Turn-ON Time	t_{on}	at specified Test Circuit	(0.29)	0.15		usec
Fall Time	t_f	"	(0.19)	0.48		usec
Storage Time	t_{stg}	"	(0.48)	0.81		usec

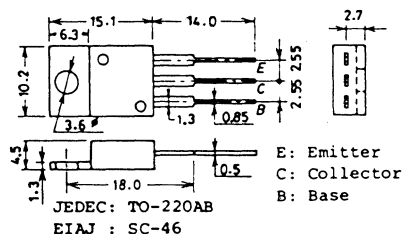
* The 2SA1011/2SC2344 are classified by 300mA h_{FE} as follows:

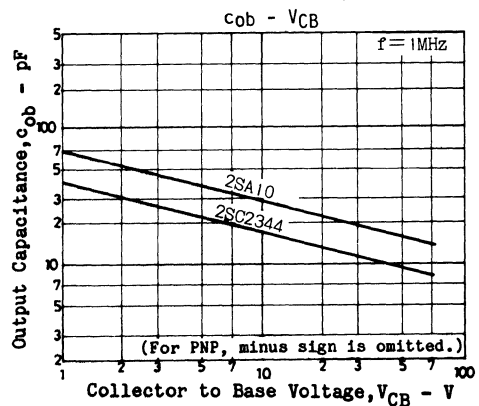
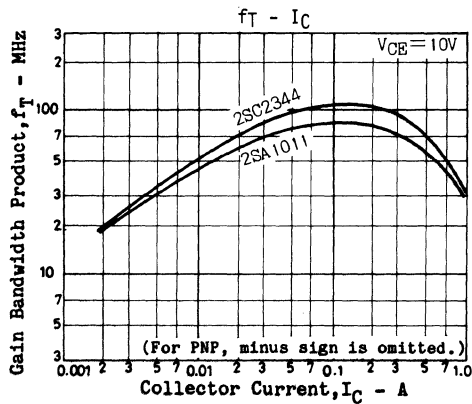
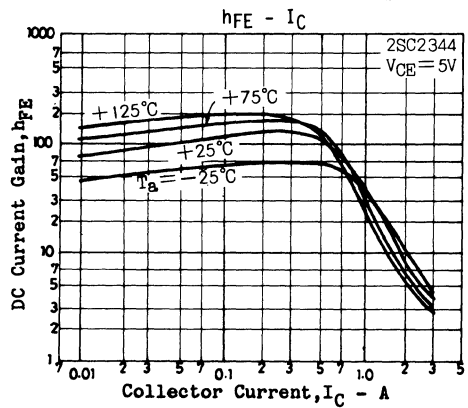
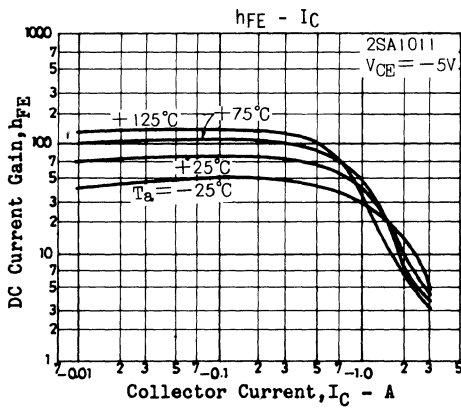
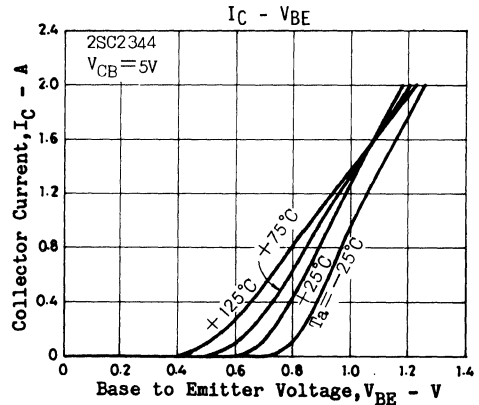
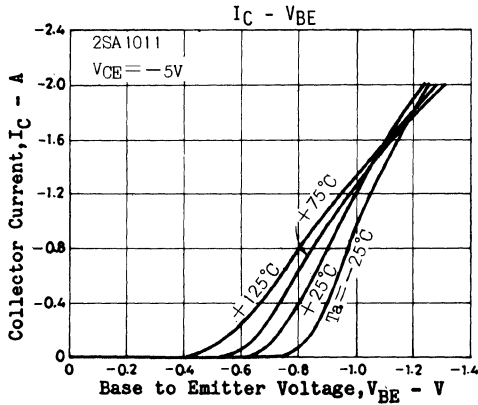
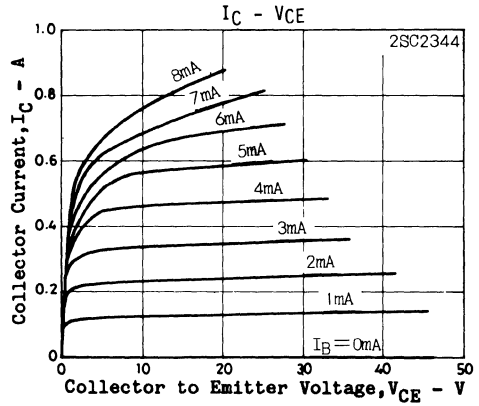
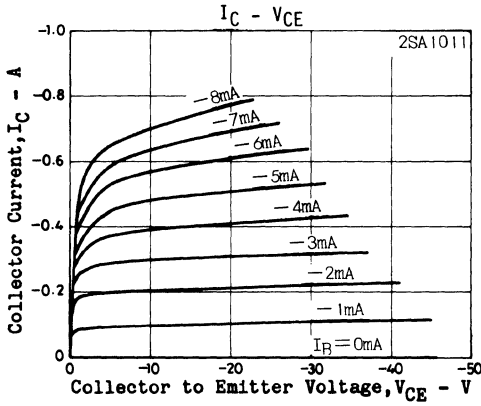
60	D	120	100	E	200
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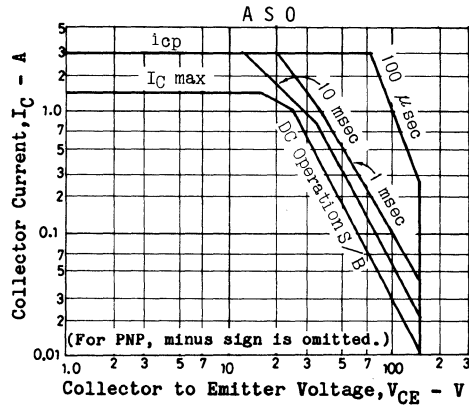
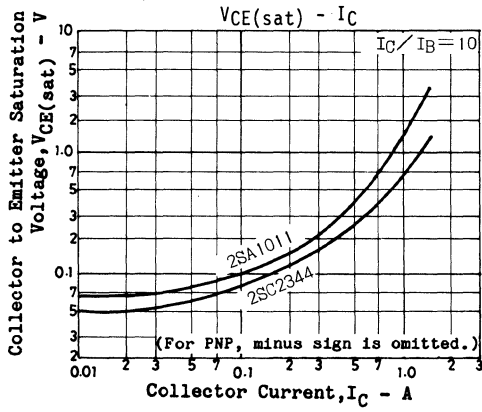
Switching Time Test Circuit



Case Outline 2010A (unit:mm)







2SC2362, 2362K



2003A

NPN/PNP Epitaxial Planar
Silicon Transistors

**2SA1016,
1016K**

High Voltage, Low Noise Amp Applications

©572C

(): 2SA1016, 1016K

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

	2SA1016, 2SC2362	2SA1016K, 2SC2362K	unit
Collector to Base Voltage	V_{CB0}	(-) 120	V
Collector to Emitter Voltage	V_{CE0}	(-) 100	V
Emitter to Base Voltage	V_{EB0}	(-) 5	V
Collector Current	I_C	(-) 50	mA
Peak Collector Current	i_{cp}	(-) 100	mA
Collector Dissipation	P_C	400	mW
Junction Temperature	T_j	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +125	$^\circ\text{C}$

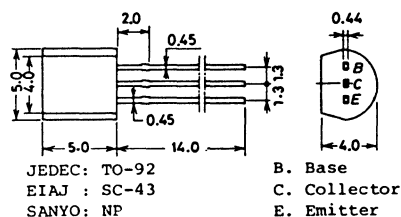
Electrical Characteristics at $T_a=25^\circ\text{C}$

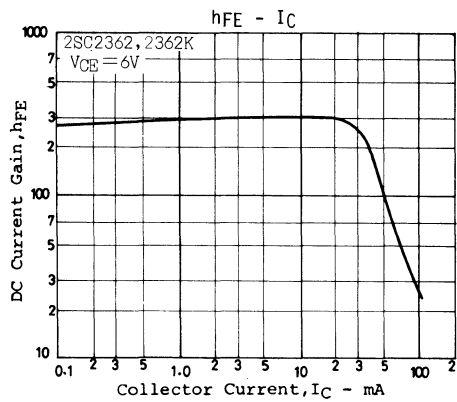
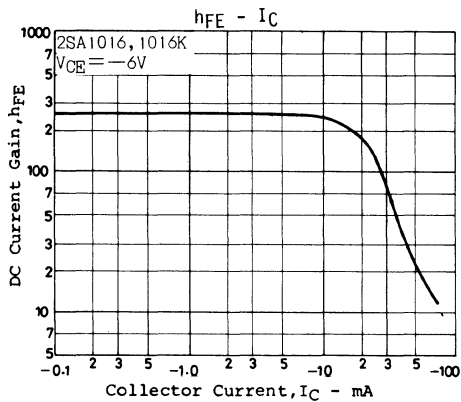
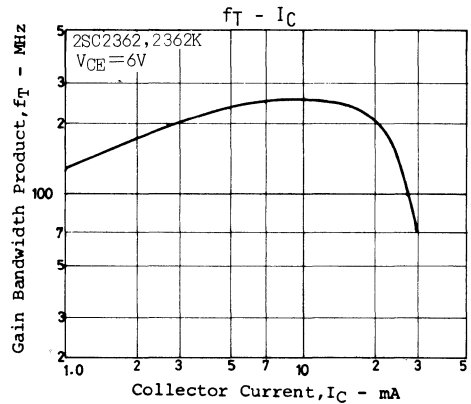
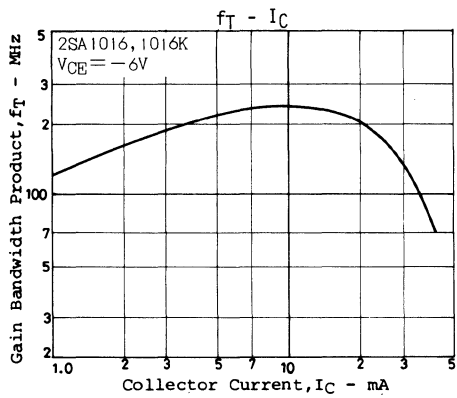
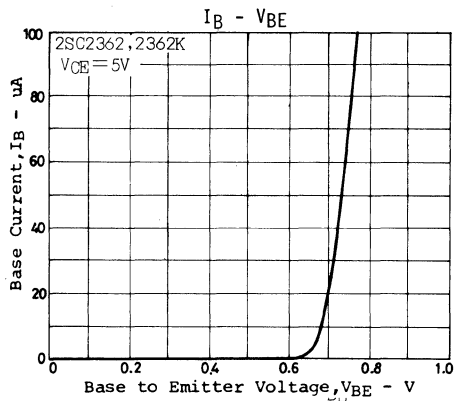
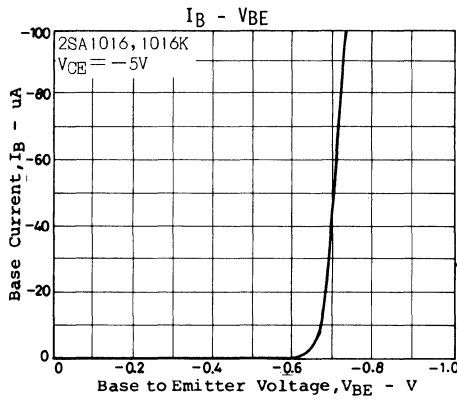
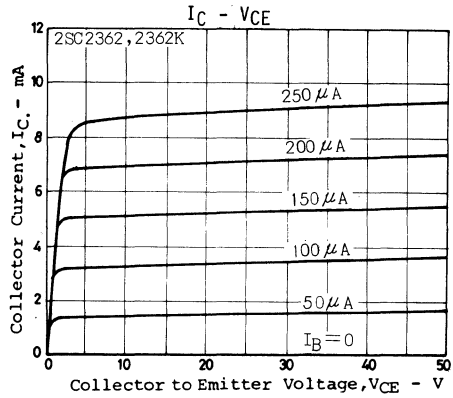
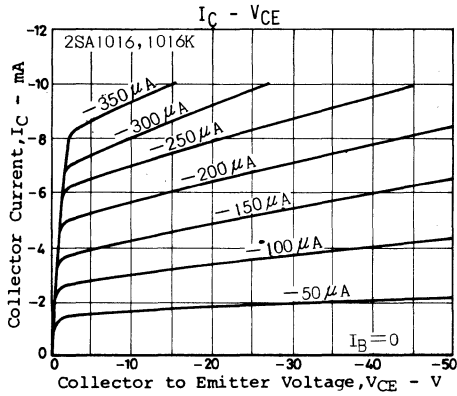
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-) 80\text{V}, I_E=0$		(-) 1.0		μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-) 4\text{V}, I_C=0$		(-) 1.0		μA
DC Current Gain	h_{FE}^*	$V_{CE}=(-) 6\text{V}, I_C=(-) 1\text{mA}$	160*		960*	
Gain Band-width Product	f_T	$V_{CE}=(-) 6\text{V}, I_C=(-) 1\text{mA}$		(110) 130		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-) 10\text{V}, f=1\text{MHz}$		(2.2) 1.8		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-) 10\text{mA}, I_E=(-) 1\text{mA}$		(-) 0.5		V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-) 10\mu\text{A}, I_E=0$		(-) 120		V
		[A1016, C2362]				
		$I_C=(-) 10\mu\text{A}, I_E=0$		(-) 150		V
		[A1016K, C2362K]				
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-) 1\text{mA}, R_{BE}=\infty$		(-) 100		V
		[A1016, C2362]				
		$I_C=(-) 1\text{mA}, R_{BE}=\infty$		(-) 120		V
		[A1016K, C2362K]				
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-) 10\mu\text{A}, I_C=0$		(-) 5		V
Noise Level	$V_{NO(ave)}$	$V_{CC}=30\text{V}, I_C=1\text{mA}, R_g=56\text{k}\Omega$			35	mV
		$V_G=77\text{dB}/1\text{kHz}$				
Noise Peak Level	$V_{NO(peak)}$	" " "			200	mV

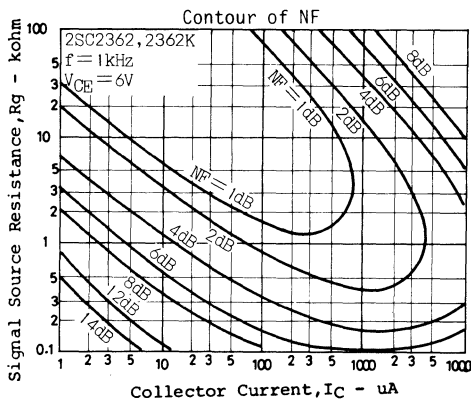
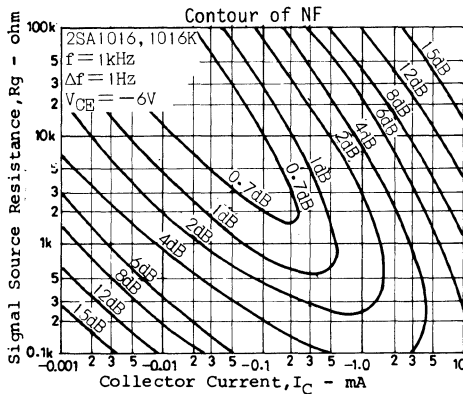
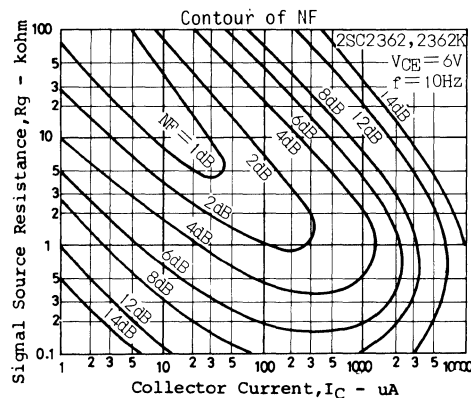
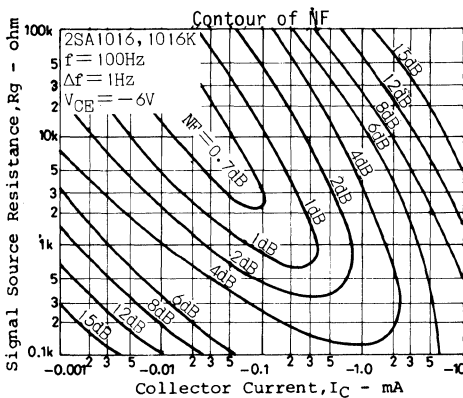
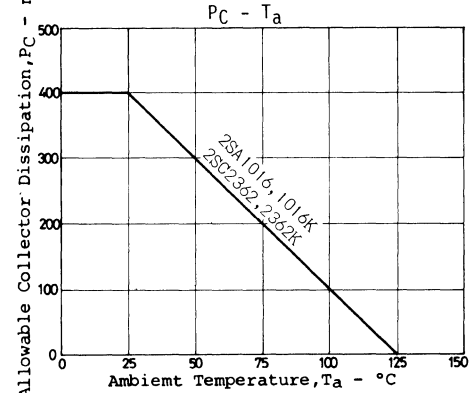
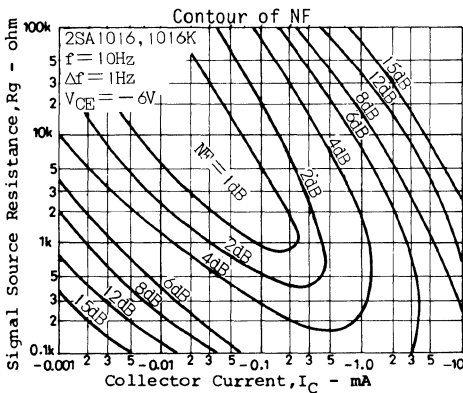
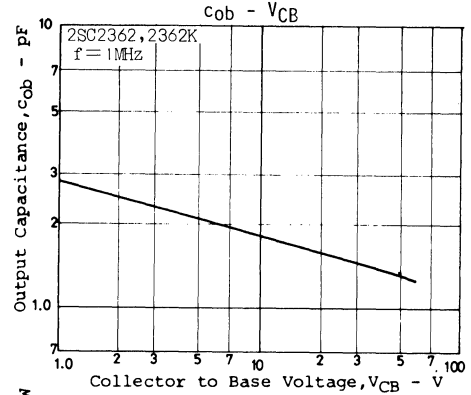
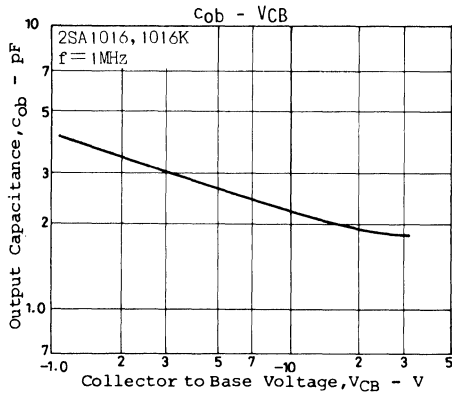
* The 2SA1016, K, 2SC2362, K are classified by 1mA h_{FE} as follows :

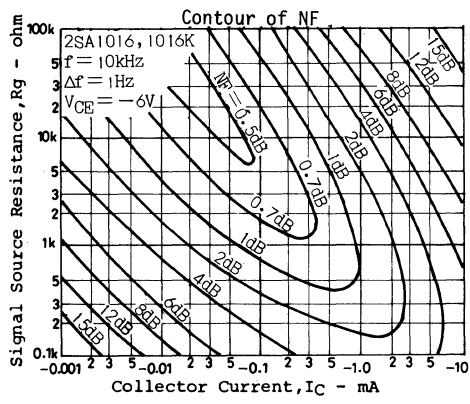
160	F	320	280	G	560	480	H	960
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Case Outline 2003A
(unit:mm)









2009

Color TV Chroma Output Applications

(E)675

unit

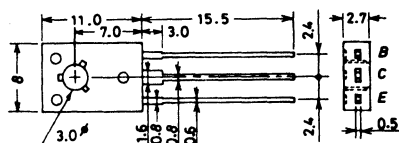
Collector to Base Voltage	V_{CBO}	300	V
Collector to Emitter Voltage	V_{CEO}	300	V
Emitter to Base Voltage	V_{EBO}	6.5	V
Collector Current	I_C	200	mA
Peak Collector Current	i_{cp}	700	mA
Allowable Power Dissipation	P_C	1.2	W
		$T_c=25^{\circ}\text{C}$	
		10	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

min	typ	max	unit
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Collector Cutoff Current	I_{CBO}	$V_{CE}=200V, I_E=0$	1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=6V, I_C=0$	1.0	μA
DC Current Gain	h_{FE}	$V_{CE}=10V, I_C=10mA$	40*	200*
Gain Band-width Product	f_T	$V_{CE}=30V, I_C=10mA$	50	MHz
Output Capacitance	C_{ob}	$V_{CB}=50V, f=1MHz$	5	pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=20mA, I_B=2mA$	0.6	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=20mA, I_B=2mA$	1.0	V

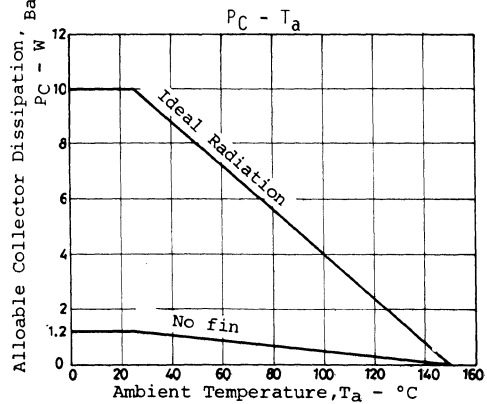
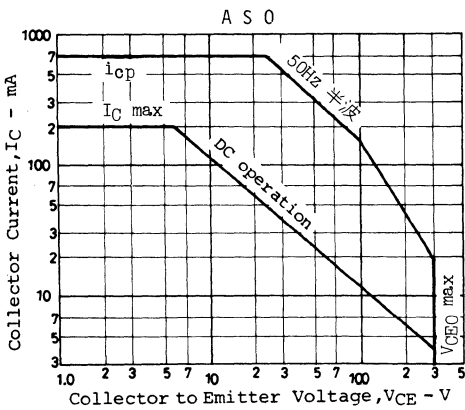
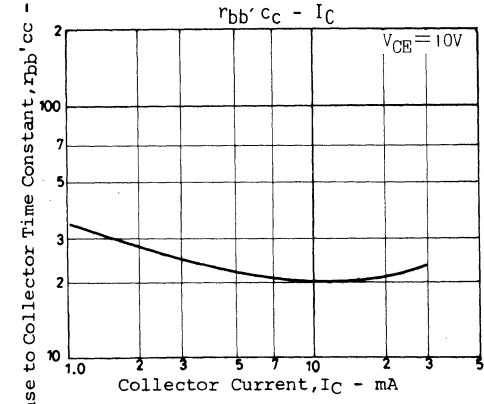
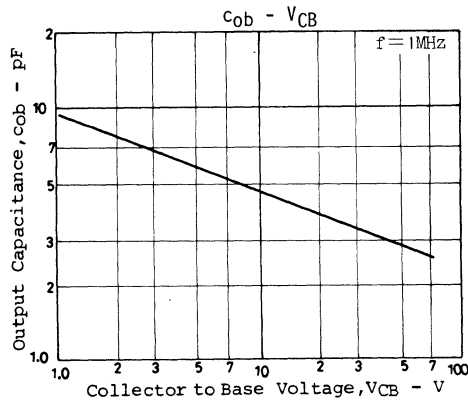
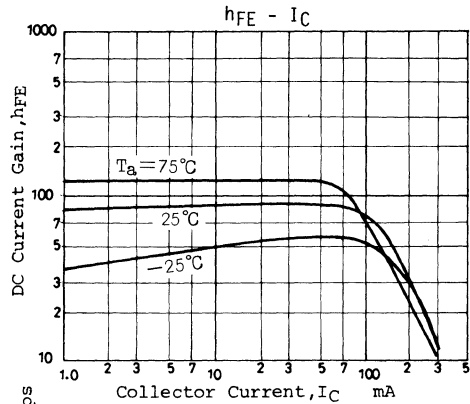
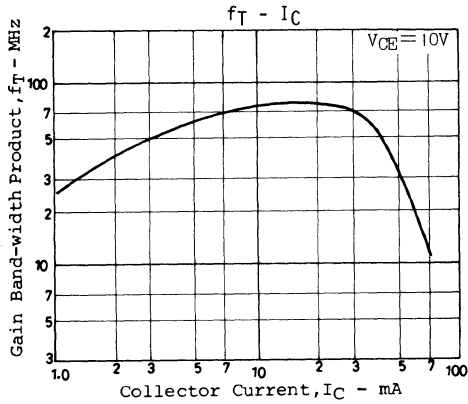
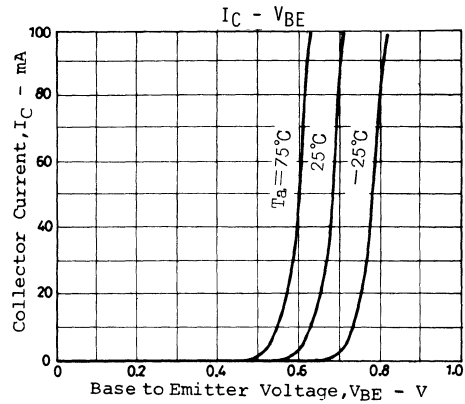
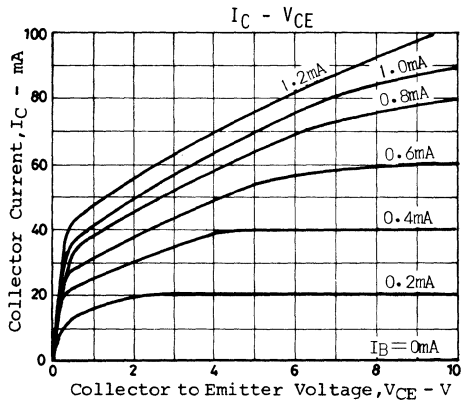
40	C	80	60	D	120	100	E	200
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(unit:mm)



JEDEC: TO-126

B: Base
C: Collector
E: Emitter



2SC2812

2018

NPN Epitaxial Planar
Silicon Transistor

Low Frequency, General-Purpose Amp Applications

Ⓔ691B

Features

- Very small package enabling compactness and slimness of sets
- High breakdown voltage ($V_{CE0} = 50\text{ V}$)

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Collector to base voltage	V_{CBO}	55	V
Collector to emitter voltage	V_{CEO}	50	V
Emitter to base voltage	V_{EBO}	5	V
Collector current	I_C	150	mA
Peak collector current	i_{cp}	300	mA
Collector dissipation	P_C	200	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage temperature	T_{stg}	$-55 \sim +125$	$^\circ\text{C}$

Electrical Characteristics/ $T_a = 25^\circ\text{C}$

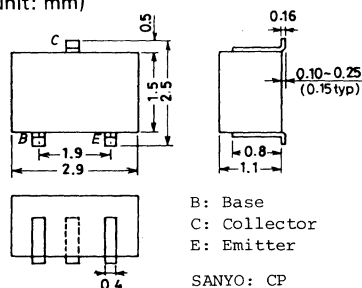
			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = 35\text{ V}, I_E = 0$			0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = 4\text{ V}, I_C = 0$			0.1	μA
DC current gain	h_{FE}	$V_{CE} = 6\text{ V}, I_C = 1\text{ mA}$	90*		600*	
Gain band-width product	f_T	$V_{CE} = 6\text{ V}, I_C = 1\text{ mA}$		100		MHz
Common base output capacitance	c_{ob}	$V_{CB} = 6\text{ V}, f = 1\text{ MHz}$		3.0		pF
Base to collector time constant	$r_{bb}C_C$	$V_{CB} = 6\text{ V}, I_C = 1\text{ mA}, f = 31.9\text{ MHz}$		250		ps
Collector to emitter saturation voltage	$V_{CE(sat)}$	$I_C = 50\text{ mA}, I_B = 5\text{ mA}$		0.1	0.5	V

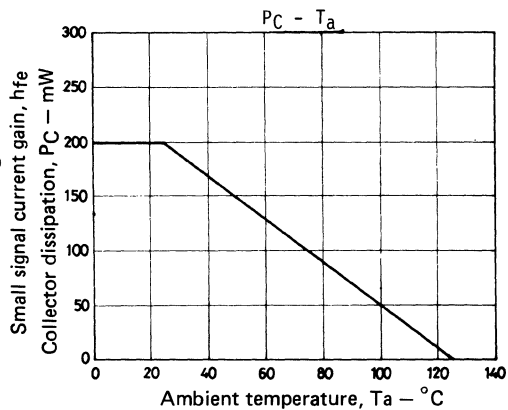
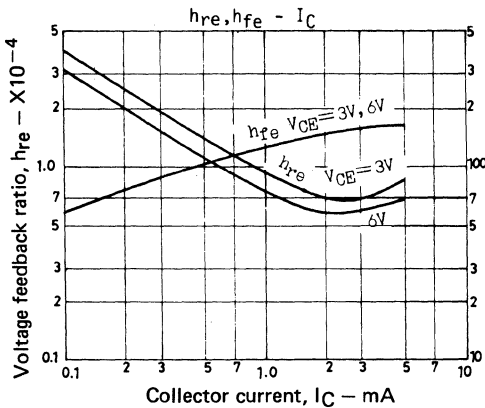
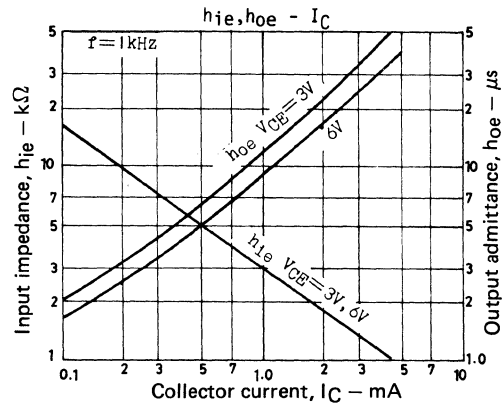
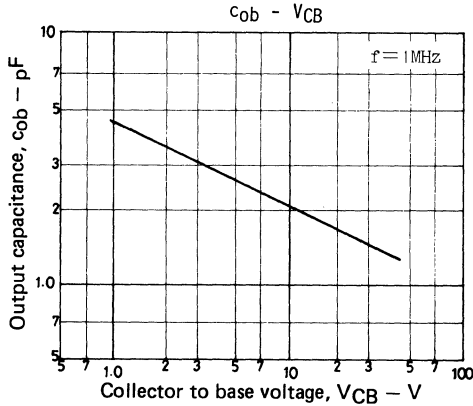
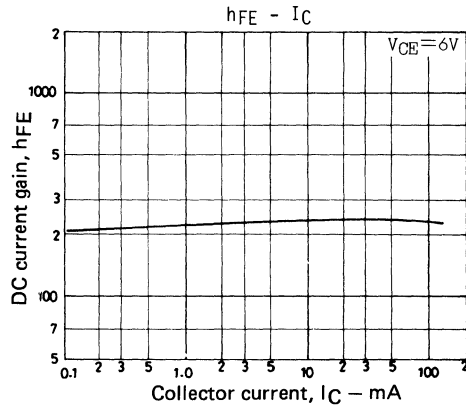
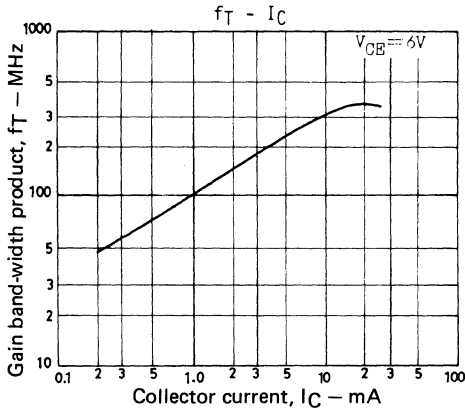
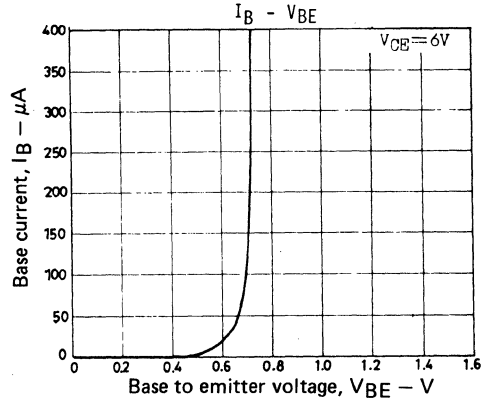
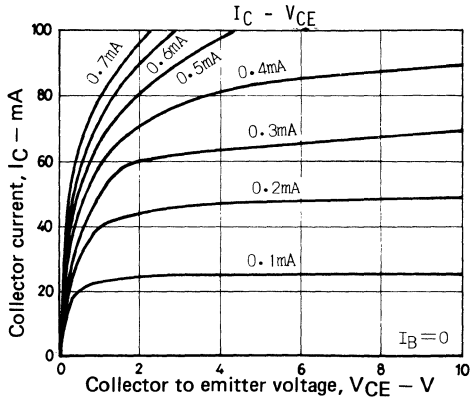
*: The 2SC812 is classified by 1 mA h_{FE} as follows:

90	L4	180	135	L5	270	200	L6	400	300	L7	600
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Case Outline 2018

(unit: mm)







High Frequency, General-Purpose Amp Applications

©692B

Features

- Very small package enabling compactness and slimness of sets
- High f_T ($f_T = 600$ MHz typ)

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	25	V
Collector to Emitter Voltage	V_{CEO}	20	V
Emitter to Base Voltage	V_{EBO}	3	V
Collector current	I_C	30	mA
Collector dissipation	P_C	150	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage temperature	T_{stg}	$-55 \sim +125$	$^\circ\text{C}$

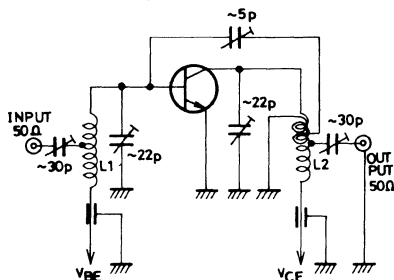
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = 10\text{V}, I_E = 0$			0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = 3\text{V}, I_C = 0$			0.1	μA
DC current gain	h_{FE}	$V_{CE} = 6\text{V}, I_C = 1\text{mA}$	40*		270*	
Gain band-width product	f_T	$V_{CE} = 6\text{V}, I_C = 4\text{mA}$	360	600		MHz
Reverse Transfer capacitance	c_{re}	$V_{CB} = 6\text{V}, f = 1\text{MHz}$		0.75	1.2	pF
Base to collector time constant	$r_{bb}C_C$	$V_{CE} = 6\text{V}, I_C = 1\text{mA}, f = 31.9\text{MHz}$			22	ps
Noise figure	NF	$V_{CE} = 6\text{V}, I_C = 1\text{mA}, f = 100\text{MHz}$		3.0		dB
Power gain	PG	$V_{CE} = 6\text{V}, I_C = 1\text{mA}, f = 100\text{MHz}$		27		dB

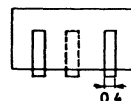
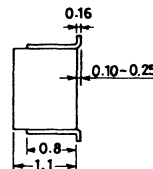
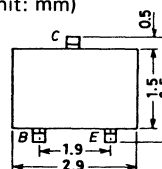
*: THE 2SC2813 is classified graded as follows by h_{FE} at 1 mA.

40	Q2	80	60	Q3	120	90	Q4	180	135	Q5	270
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NF, PG Test Circuit



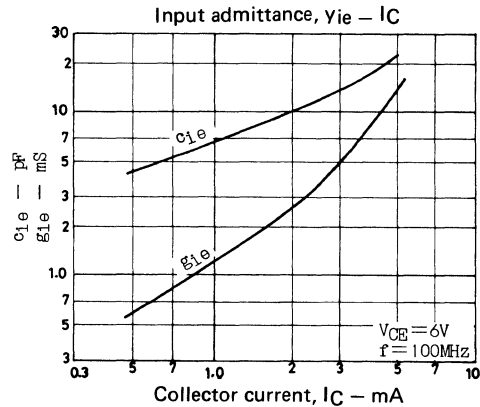
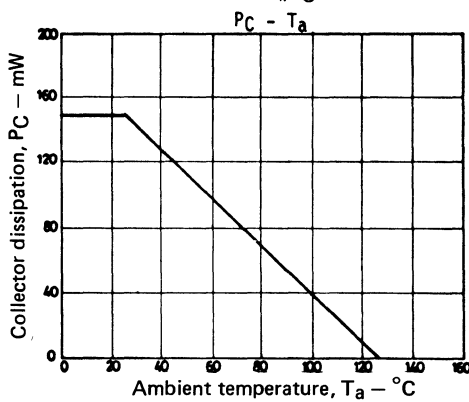
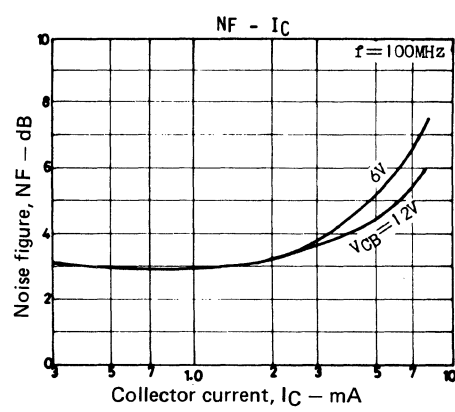
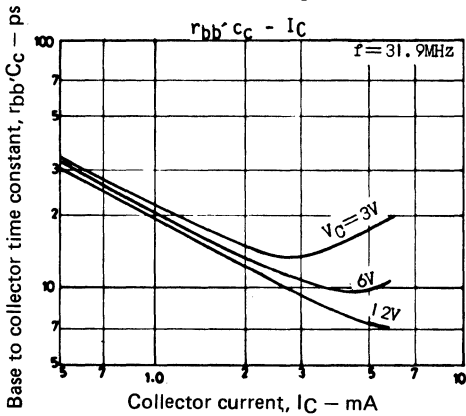
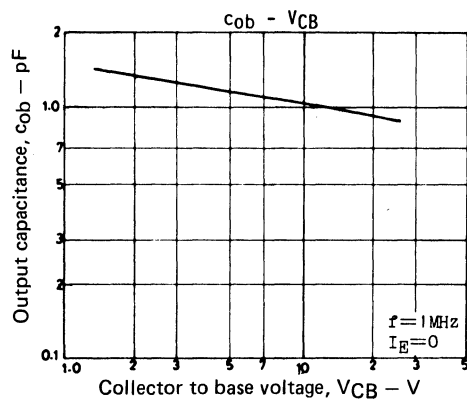
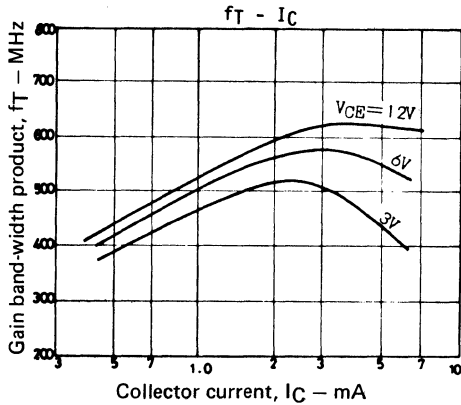
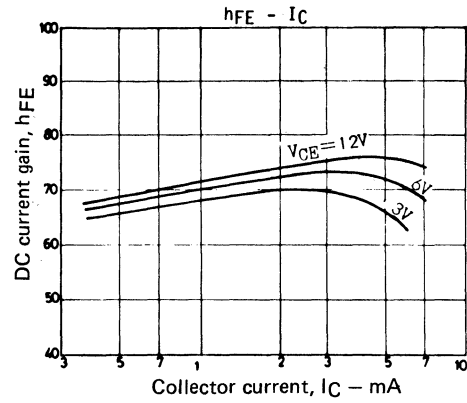
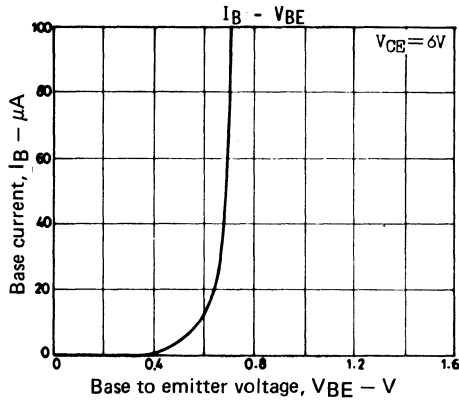
Case Outline 2018
(unit: mm)

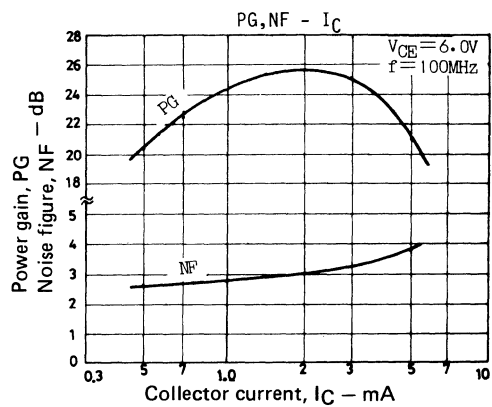
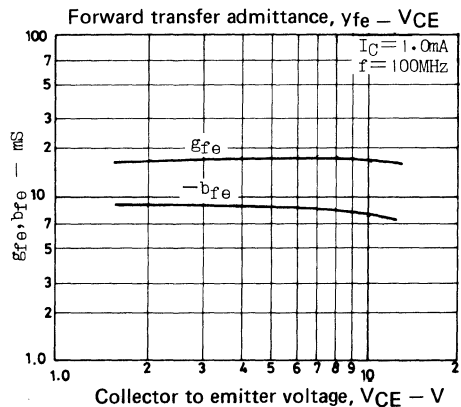
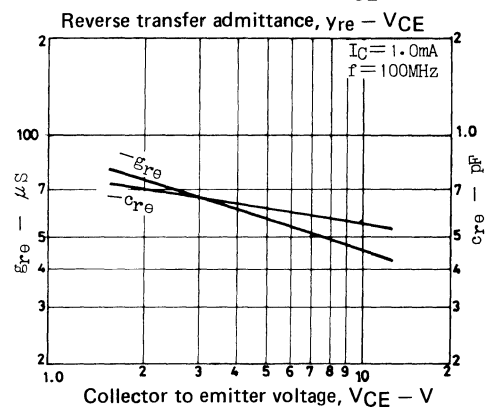
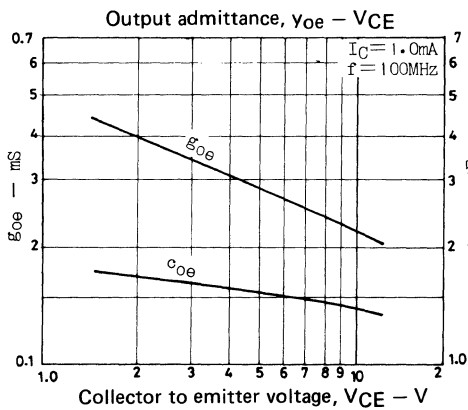
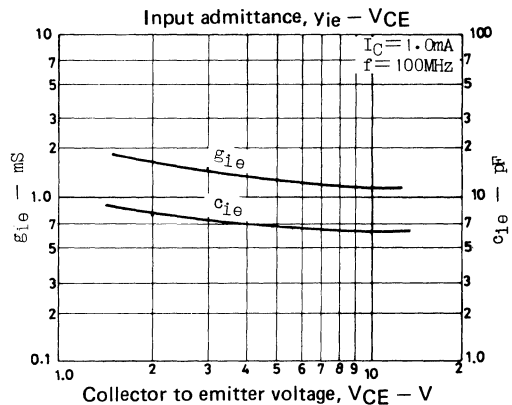
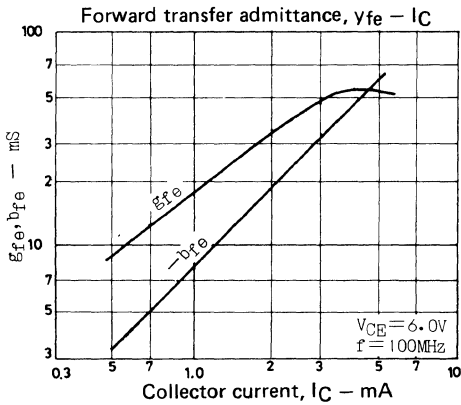
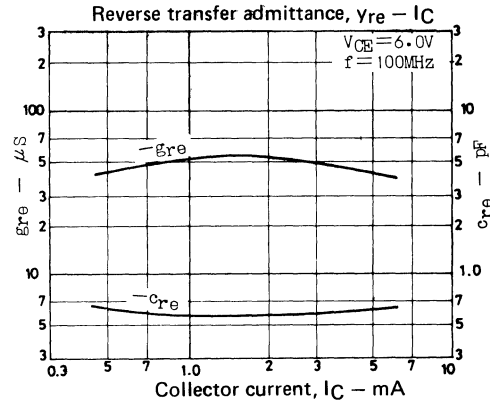
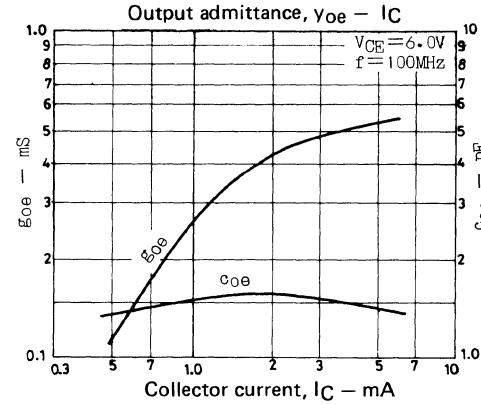


B: Base
C: Collector
E: Emitter

SANYO: CP

- L1: 1mm ϕ plated wire 10mm ϕ , 4T tap, 1T from base side
L2: 1mm ϕ plated wire 10mm ϕ , 5T tap, 2T from collector side
L3: 1mm ϕ plated wire 10mm ϕ , 2T





High Frequency, General-Purpose Amp Applications

©693E

Features

- . Very small package enabling compactness and slimness of sets.
- . High f_T and small c_{re} . ($f_T=320\text{MHz}$ typ, $c_{re}=0.95\text{pF}$ typ)

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

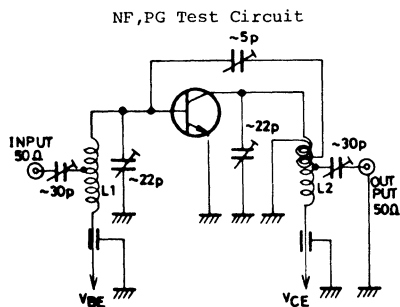
			unit
Collector to Base Voltage	V_{CB0}	30	V
Collector to Emitter Voltage	V_{CE0}	20	V
Emitter to Base Voltage	V_{EB0}	5	V
Collector Current	I_C	30	mA
Collector Dissipation	P_C	150	mW
Junction Temperature	T_j	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +125	$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=10\text{V}, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=4\text{V}, I_C=0$			0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=6\text{V}, I_C=1\text{mA}$	40*		270*	
Gain Bandwidth Product	f_T	$V_{CE}=6\text{V}, I_C=1\text{mA}$	200	320		MHz
Reverse Transfer Capacitance	c_{re}	$V_{CB}=6\text{V}, f=1\text{MHz}$	0.7	0.95	1.2	pF
Base to Collector Time Constant	$r_{bb}'C_C$	$V_{CE}=6\text{V}, I_C=1\text{mA}, f=31.9\text{MHz}$		12	20	ps
Noise Figure	NF	$V_{CE}=6\text{V}, I_C=1\text{mA}, f=100\text{MHz}$		3.0		dB
Power Gain	PG	$V_{CE}=6\text{V}, I_C=1\text{mA}, f=100\text{MHz}$		25		dB

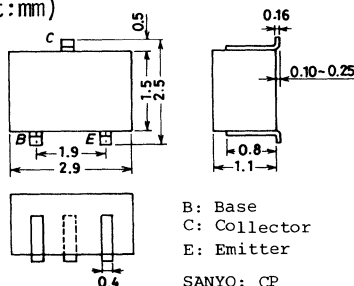
* : The 2SC2814 is classified as follows by h_{FE} at 1mA.

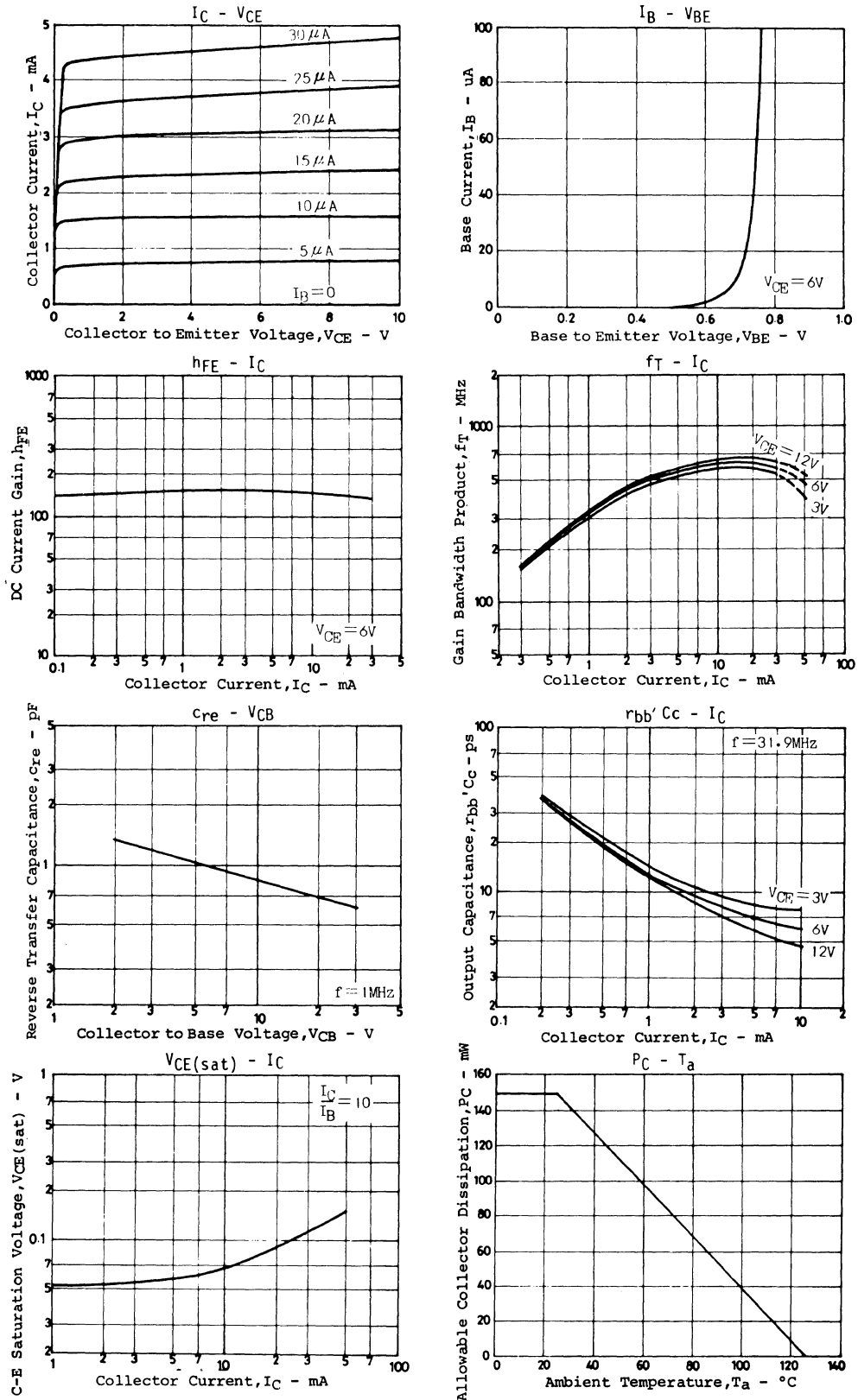
40	F2	80	60	F3	120	90	F4	180	135	F5	270
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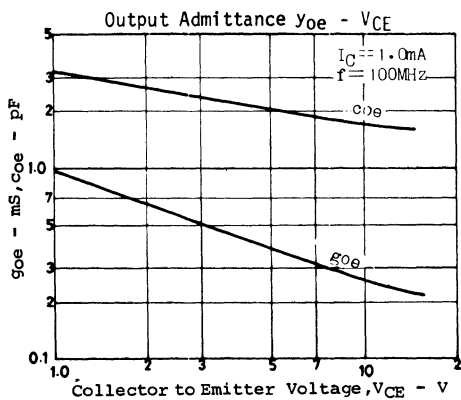
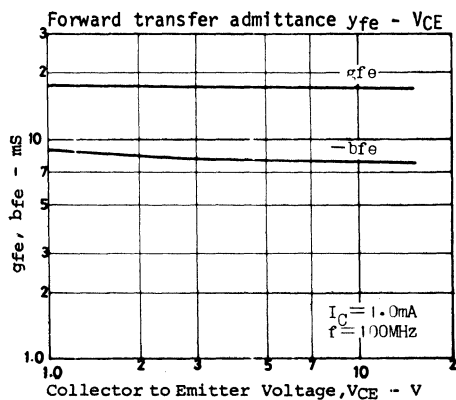
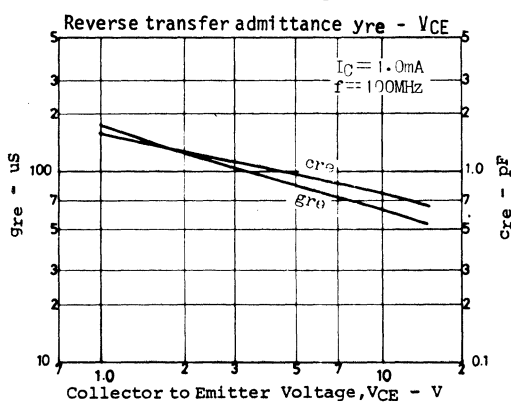
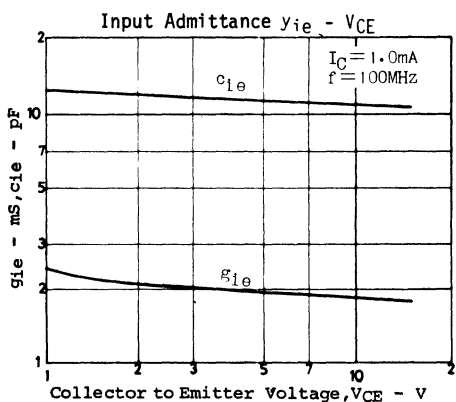
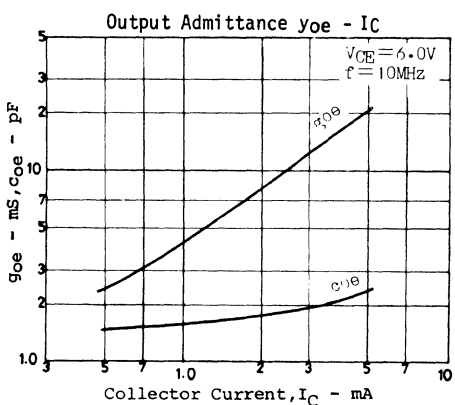
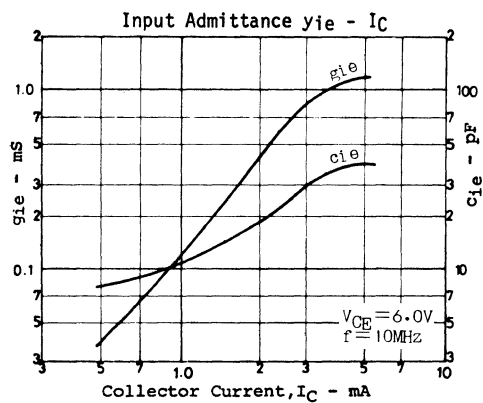
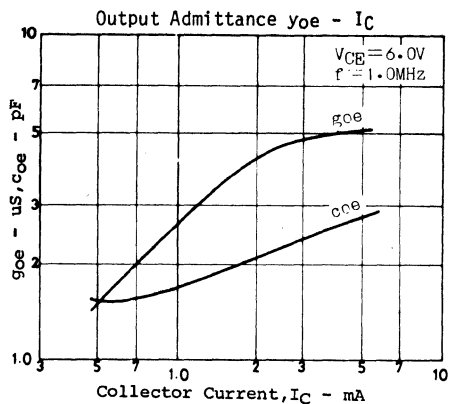
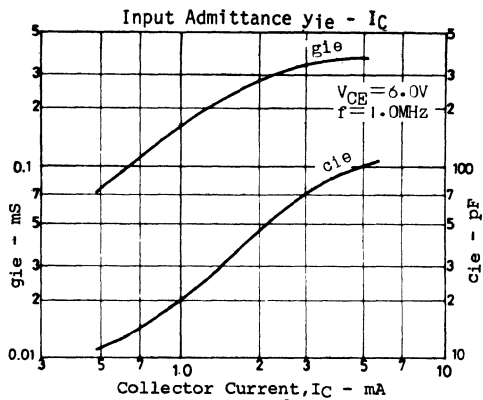


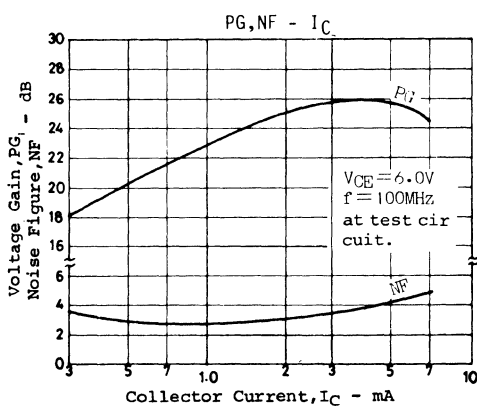
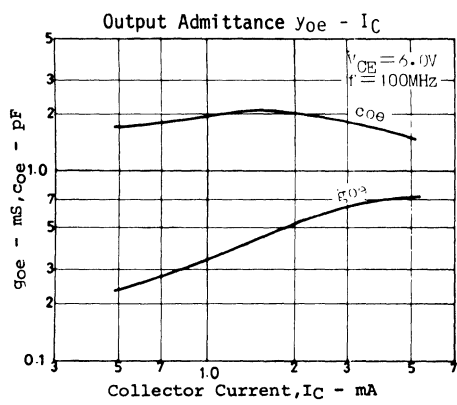
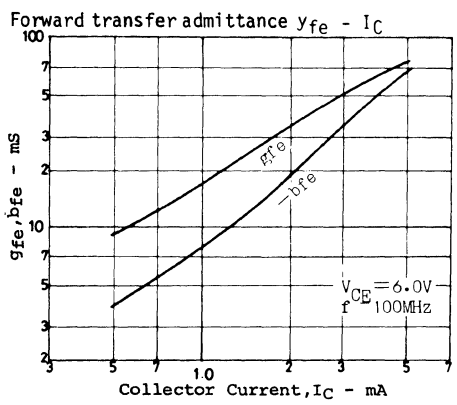
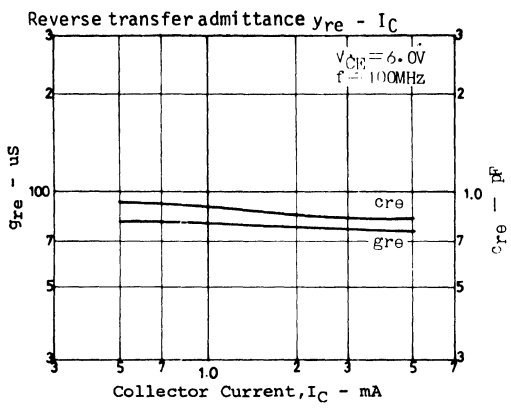
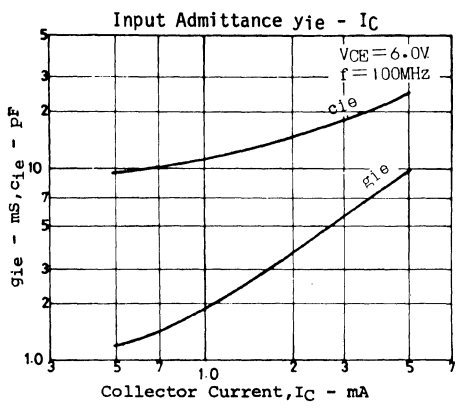
- L1 : 1mm ϕ plated wire 10mm ϕ 4T tap, 2T from base side.
L2 : 1mm ϕ plated wire 10mm ϕ 7T tap, 1T from collector side.
L3 : 1mm ϕ plated wire 10mm ϕ 3T.

Case Outline 2018 (unit:mm)









2SC2839



2000B

NPN Epitaxial Planar
Silicon Transistor

High Frequency, General-Purpose Amp Applications

©733B

Features

- . Very small package enabling compactness and slimness of sets.
- . High f_T and small c_{re} . ($f_T=320\text{MHz typ}$, $c_{re}=0.95\text{ typ}$)

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	30	V
Collector to Emitter Voltage	V_{CEO}	20	V
Emitter to Base Voltage	V_{EBO}	5	V
Collector Current	I_C	30	mA
Collector Dissipation	P_C	150	mW
Junction Temperature	T_j	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +125	$^\circ\text{C}$

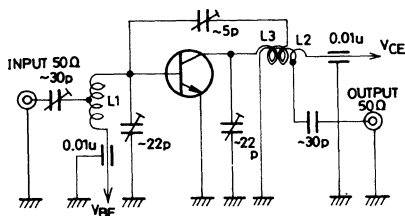
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=10\text{V}, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4\text{V}, I_C=0$			0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=6\text{V}, I_C=1\text{mA}$	60*		320*	
Gain Bandwidth Product	f_T	$V_{CE}=6\text{V}, I_C=1\text{mA}$	200	320		MHz
Reverse Transfer Capacitance	c_{re}	$V_{CB}=6\text{V}, f=1\text{MHz}$	0.7	0.95	1.3	pF
Base to Collector Time Constant	$r_{bb}'C_c$	$V_{CB}=6\text{V}, I_C=1\text{mA}, f=31.9\text{MHz}$	12	20		ps
Noise Figure	NF	$V_{CE}=6\text{V}, I_C=1\text{mA}, f=100\text{MHz}$	3.0			dB
Power Gain	PG	$V_{CE}=6\text{V}, I_C=1\text{mA}, f=100\text{MHz}$	25			dB

* : The 2SC2839 is classified as follows by h_{FE} at 1mA.

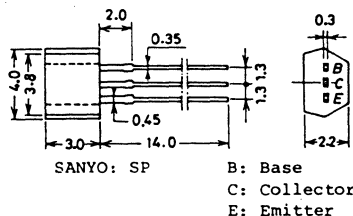
60	D	120	100	E	200	160	F	320
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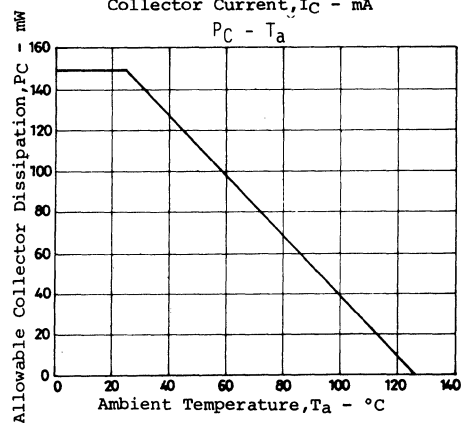
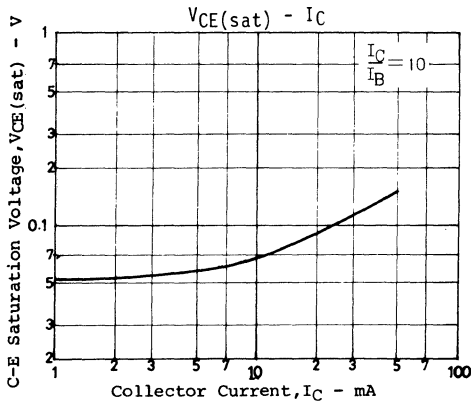
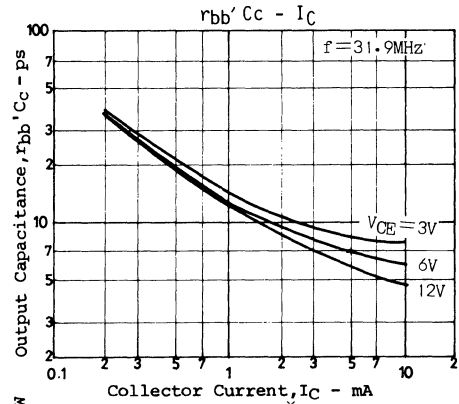
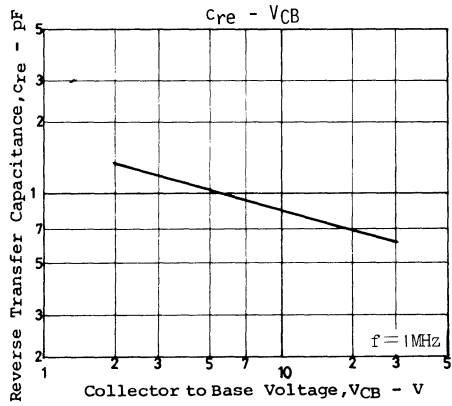
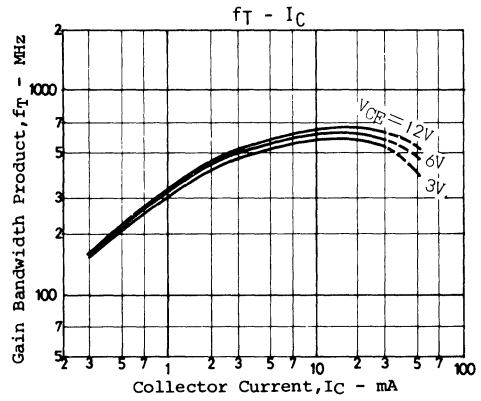
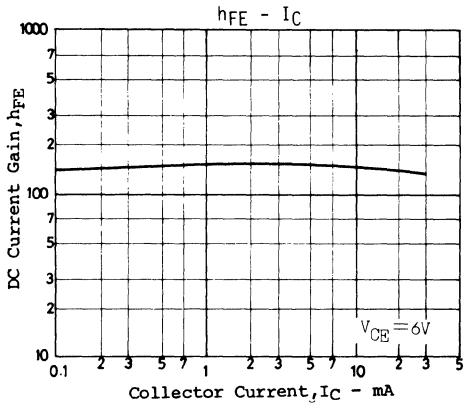
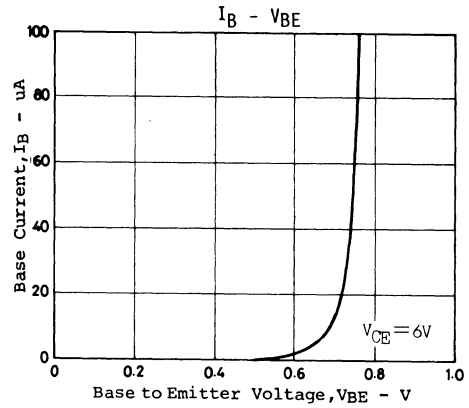
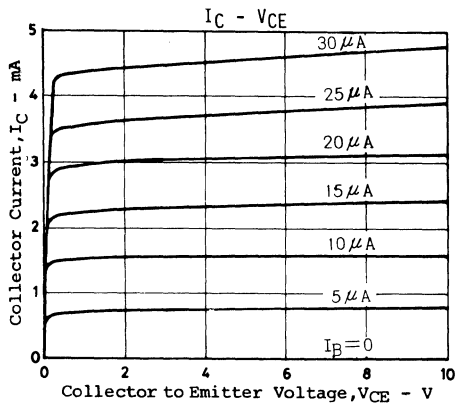
NF PG Test Circuit

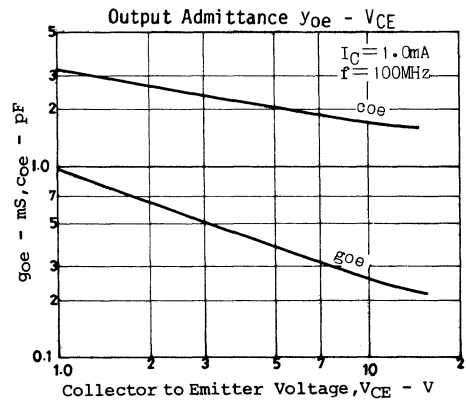
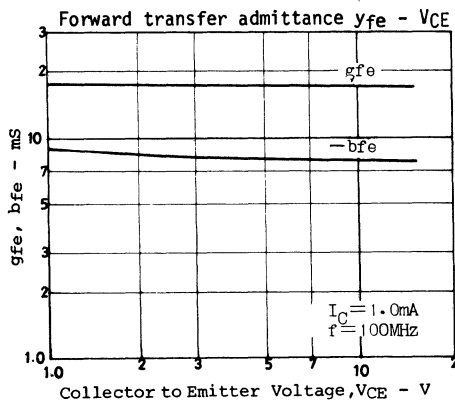
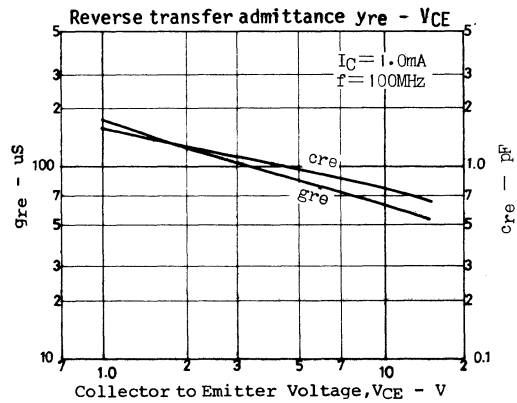
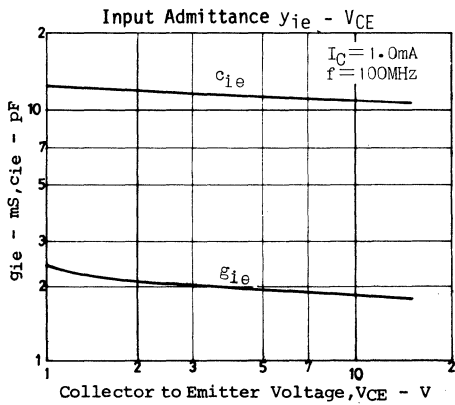
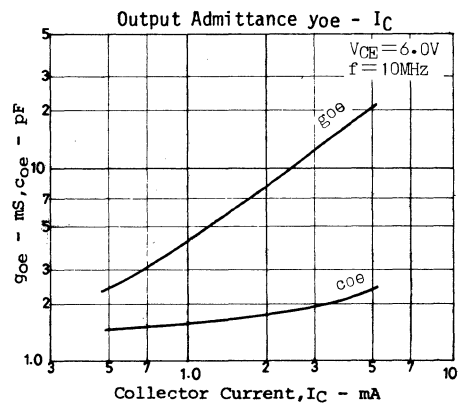
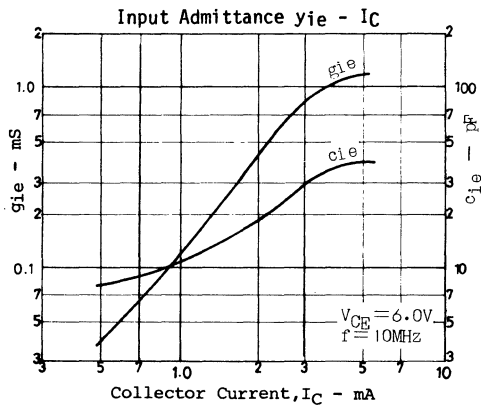
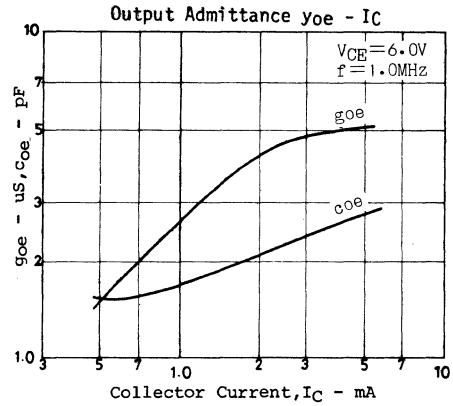
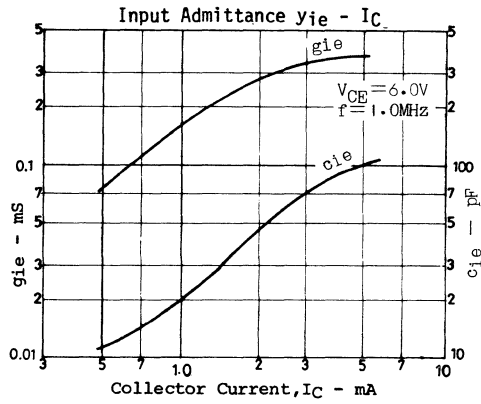


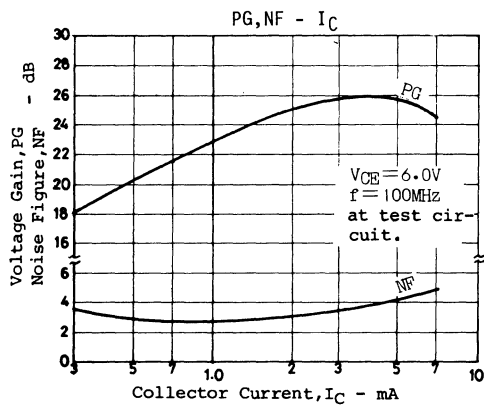
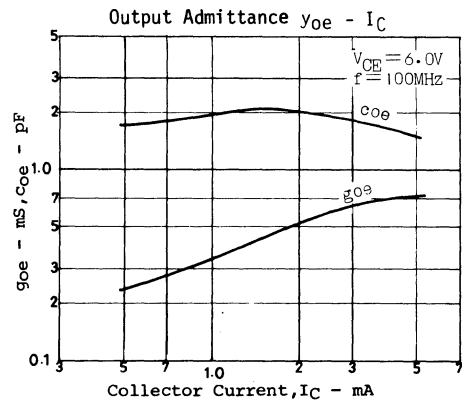
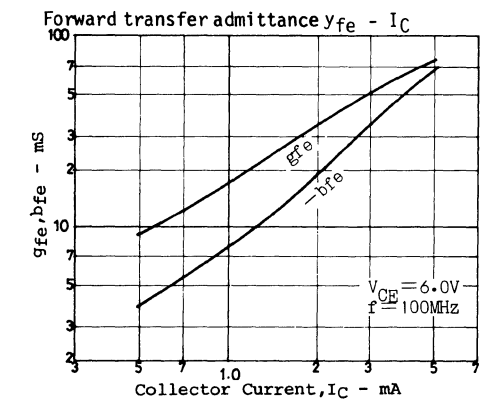
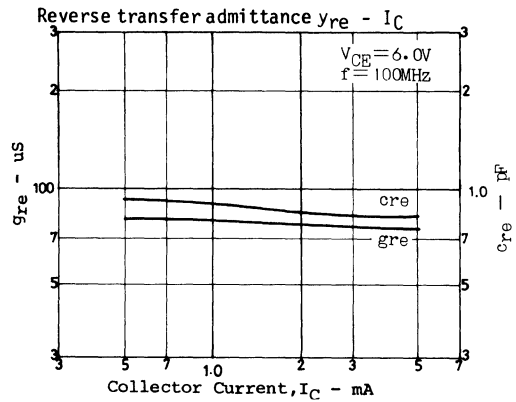
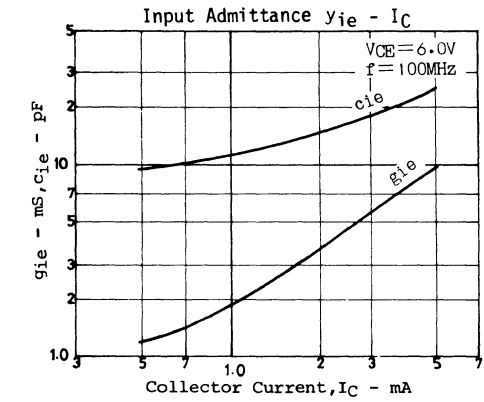
- L1 : 1mmφ plated wire 10mmφ, 5T tap, 2T from base side.
L2 : 1mmφ plated wire 10mmφ, 7T tap, 1T from collector side.
L3 : 1mmφ plated wire 10mmφ, 3T.

Case Outline 2000B
(unit:mm)









2SC2840



2000B

NPN Epitaxial Planar
Silicon Transistor

High Frequency, General-Purpose Amp Applications

©796A

Features

- . FBET series.
- . Compact package enabling compactness of sets.
- . High f_T and small c_{re} ($f_T=600\text{MHz}$ typ, $c_{re}=0.5$ typ).

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

		unit
Collector to Base Voltage	V_{CBO}	25 V
Collector to Emitter Voltage	V_{CEO}	20 V
Emitter to Base Voltage	V_{EBO}	3 V
Collector Current	I_C	30 mA
Collector Dissipation	P_C	150 mW
Junction Temperature	T_j	125 $^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to +125 $^\circ\text{C}$

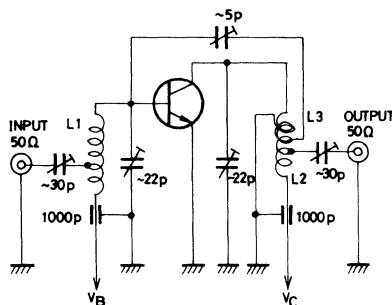
Electrical Characteristics at $T_a=25^\circ\text{C}$

		min	typ	max	unit
Collector Cutoff Current	I_{CBO}			0.1	μA
Emitter Cutoff Current	I_{EBO}			0.1	μA
DC Current Gain	h_{FE}		40*	200*	
Gain Bandwidth Product	f_T		360	600	MHz
Reverse Transfer Capacitance	c_{re}		0.5	0.8	pF
C-B Time Constant	$r_{bb}'C_c$			19	ps
Noise Figure	NF			2.8	dB
Power Gain	PG			27	dB

* The 2SC2840 is classified by $1\text{mA } h_{FE}$ as follows :

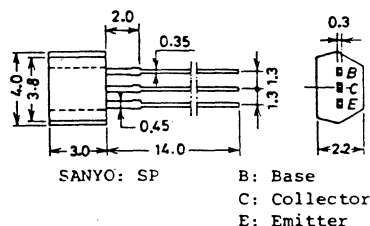
40	C	80	60	D	120	100	E	200
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NF, PC Test Circuit

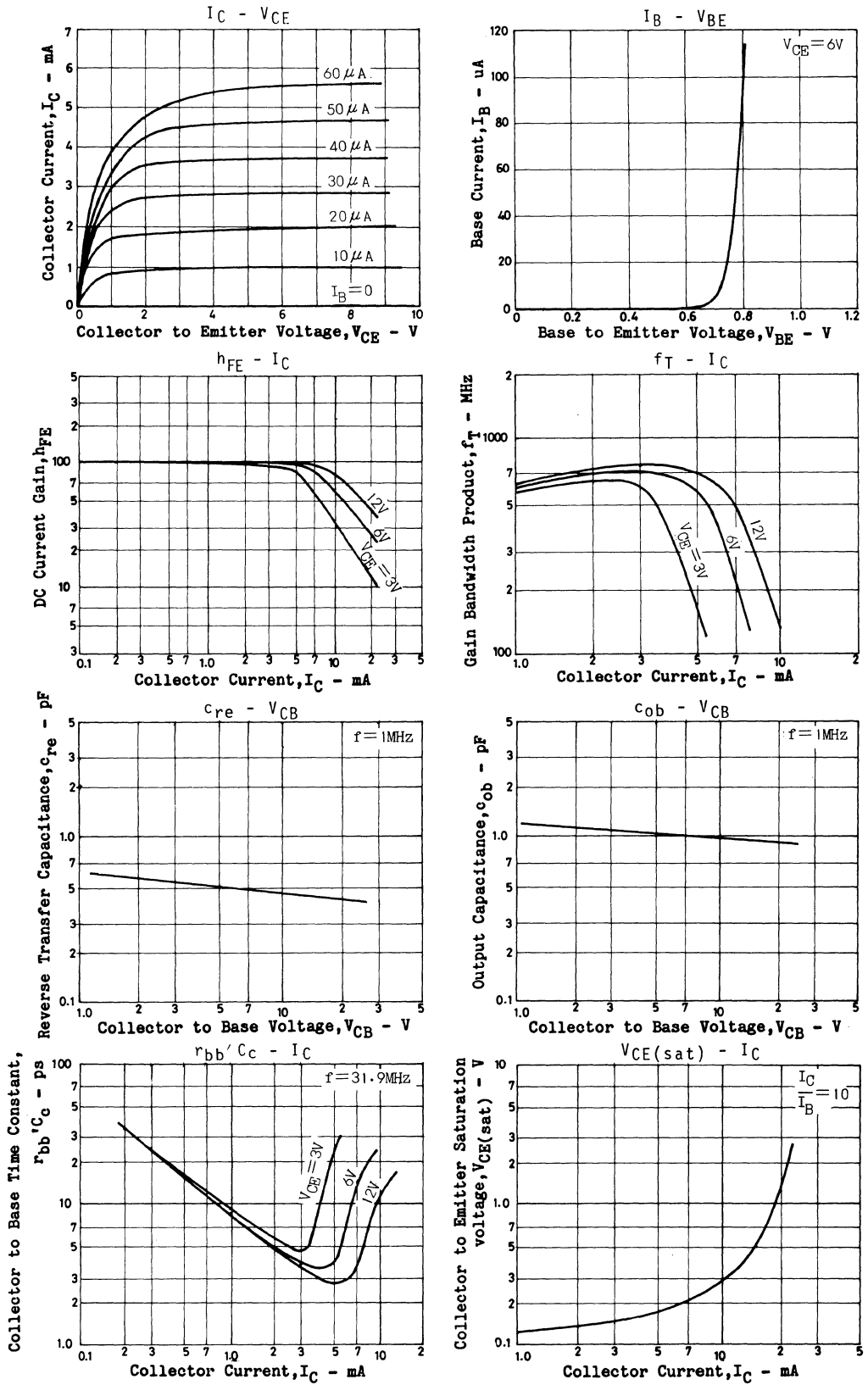


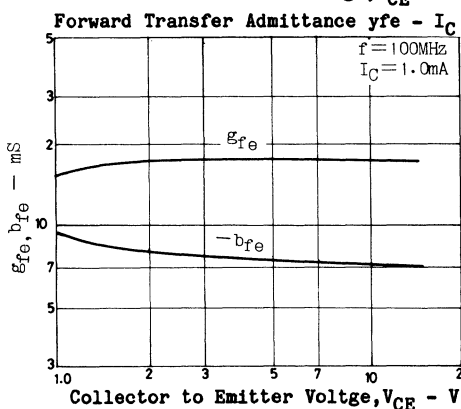
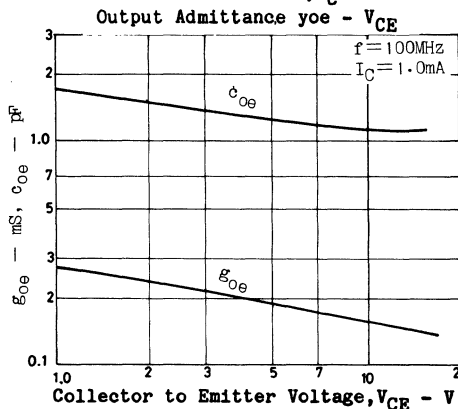
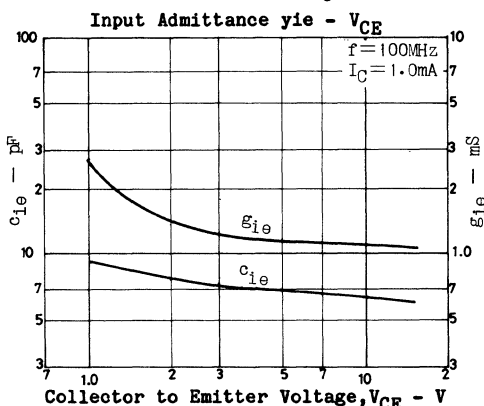
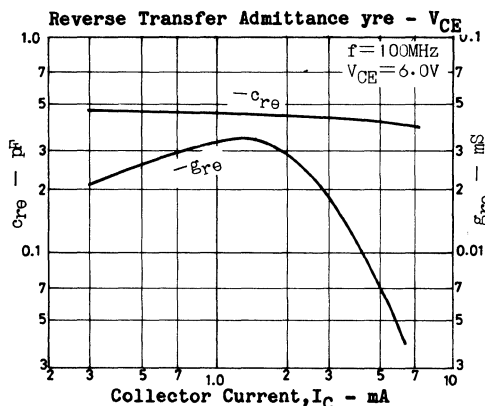
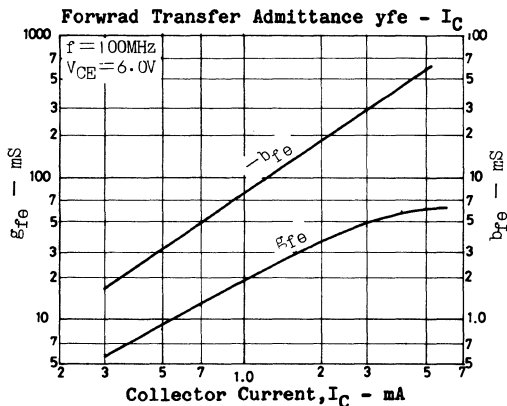
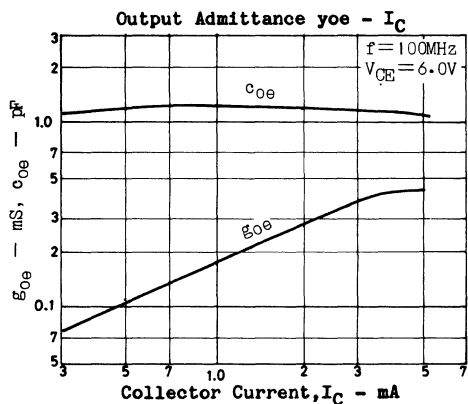
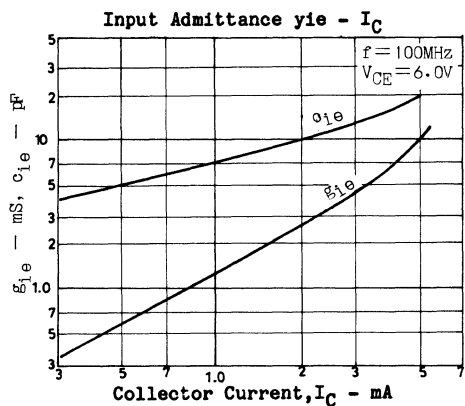
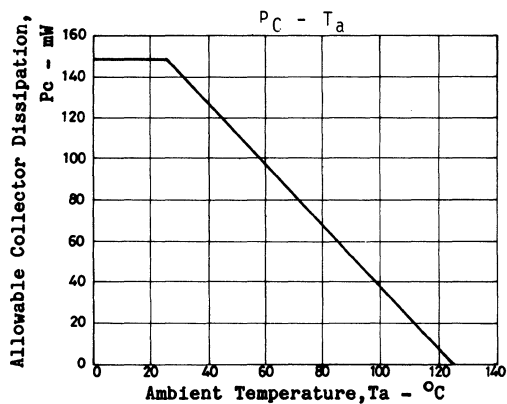
- L1: 1mm ϕ plated wire, 10mm ϕ 5T, Pitch 15mm, tap:
2T from base.
L2: 1mm ϕ plated wire, 10mm ϕ 7T, Pitch 10mm, tap:
2T from V_C .
L3: 1mm ϕ enameled wire, 10mm ϕ 3T, Pitch 10mm.

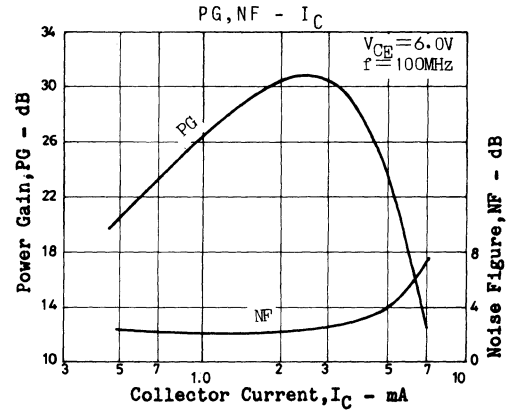
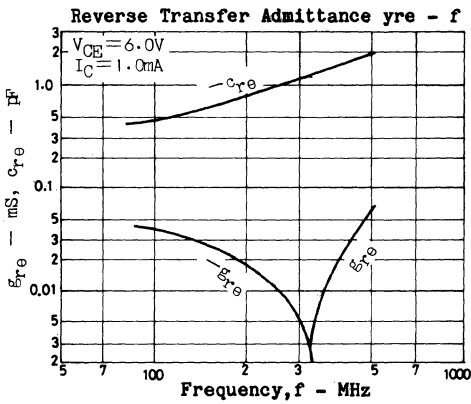
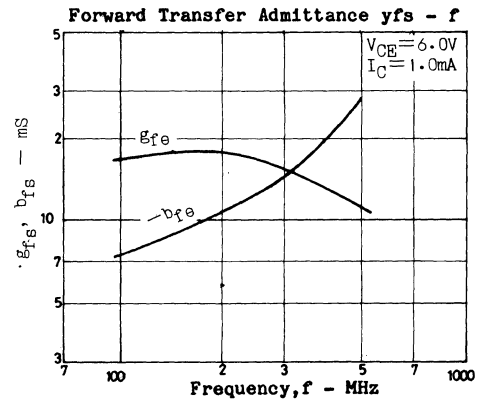
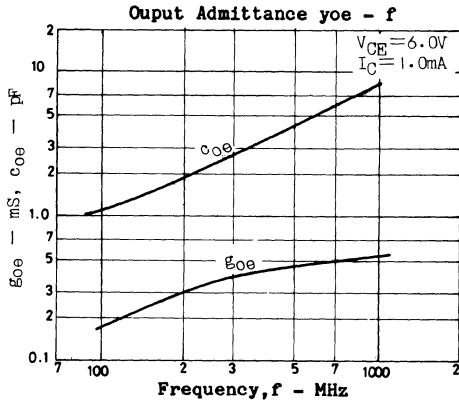
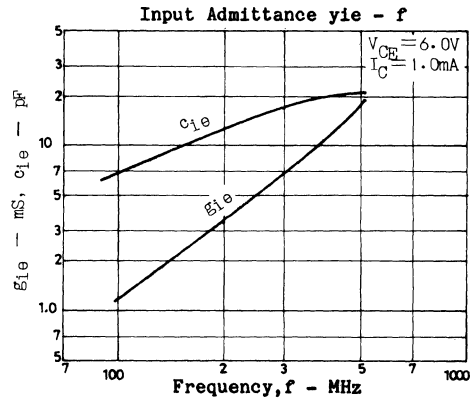
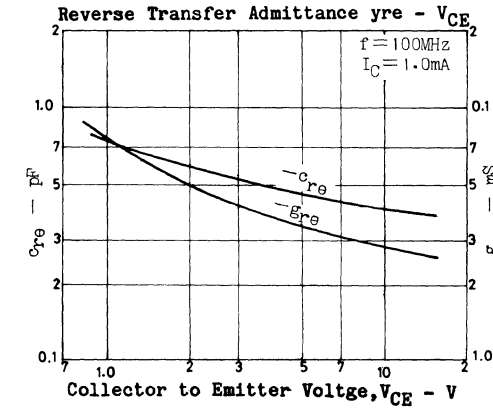
Case Outline 2000B (unit:mm)



B: Base
C: Collector
E: Emitter







2SC2857



2003A

NPN Triple Diffused Planar
Silicon Transistor

High Voltage Driver Applications

©753B

Applications

- * Color TV vertical driver, sound driver applications

Features

- * High breakdown voltage ($V_{CE0} \geq 180V$)
- * High collector dissipation ($P_C = 500mW$)

Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	180	V
Collector to Emitter Voltage	V_{CEO}	180	V
Emitter to Base Voltage	V_{EBO}	5	V
Collector Current	I_C	100	mA
Peak Collector Current	i_{cp}	100	mA
Allowable Power Dissipation	P_C	500	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a = 25^\circ C$

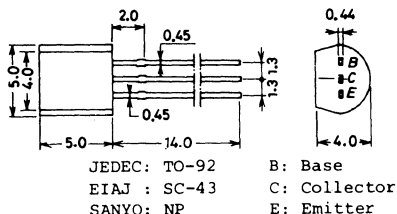
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = 180V, I_E = 0$			1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 5V, I_C = 0$			1.0	μA
DC Current Gain	h_{FE}	$V_{CE} = 10V, I_C = 10mA$	40*		320*	
Gain Band-width Product	f_T	$V_{CE} = 30V, I_C = 10mA$	50			MHz
Output Capacitance	c_{ob}	$V_{CB} = 10V, f = 1MHz$			4.0	pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = 20mA, I_B = 2mA$			0.6	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = 20mA, I_B = 2mA$			1.0	V

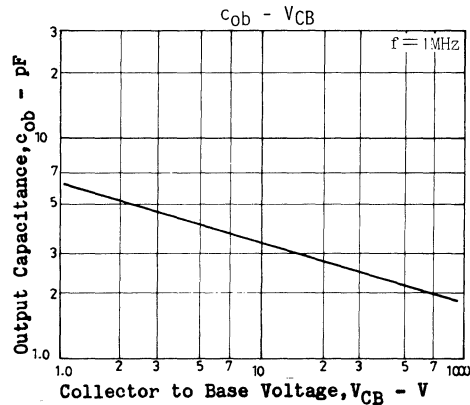
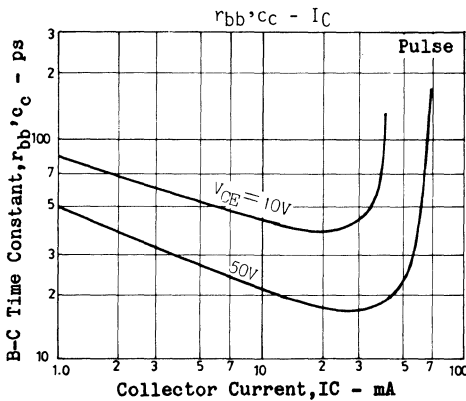
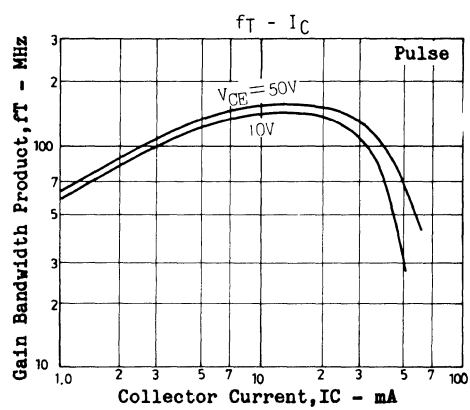
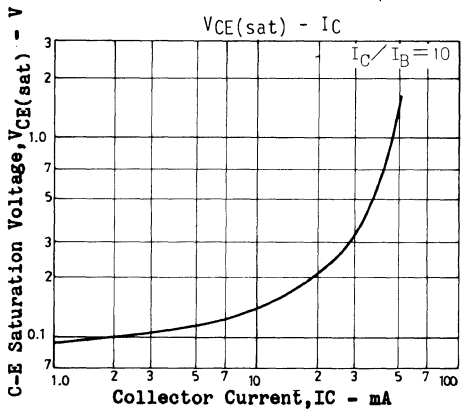
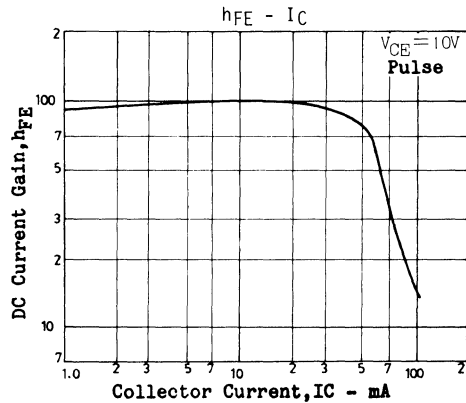
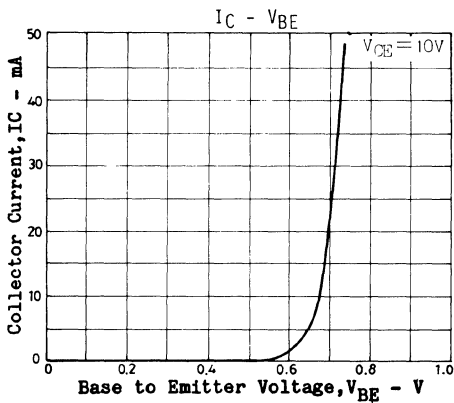
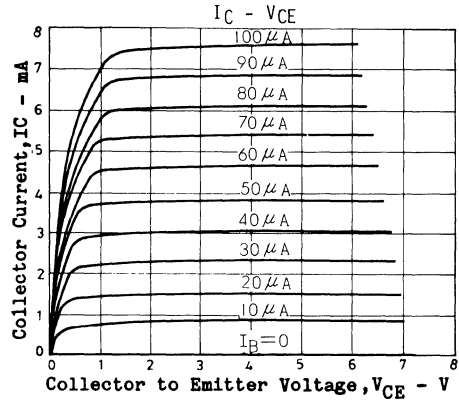
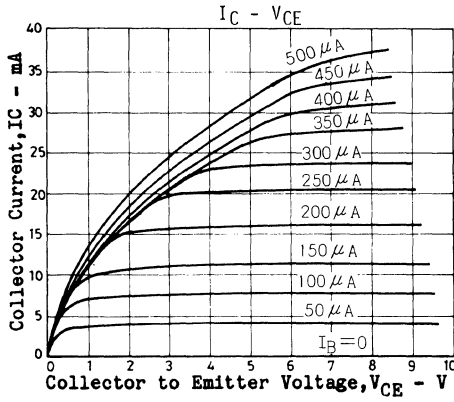
* The 2SC2857 is classified by 10mA h_{FE} as follows :

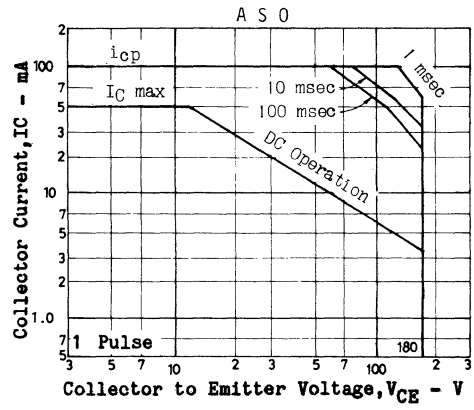
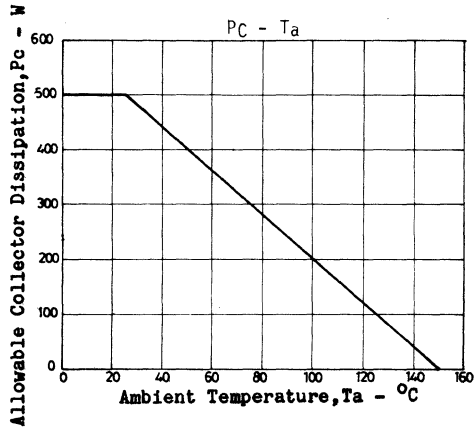
40	C	80	60	D	120	100	E	200	160	F	320
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Case Outline 2003A

(unit:mm)







2SC2909



2003A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1207

High Voltage Switching, AF 60W Predriver Applications

©778C

Features

- . Adoption of FBET process.
- . High breakdown voltage.
- . Excellent linearity of h_{FE} and small c_{ob} .
- . Fast switching speed.

(): 2SA1207

Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)180	V
Collector to Emitter Voltage	V_{CEO}	(-)160	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)70	mA
Peak Collector Current	i_{cp}	(-)140	mA
Collector Dissipation	P_C	600	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

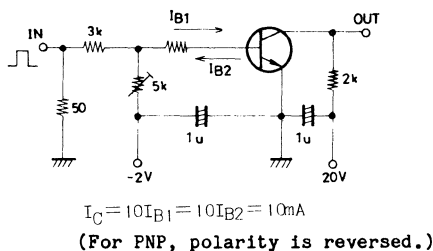
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80\text{V}, I_E=0$		(-)0.1		μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$		(-)0.1		μA
DC Current Gain	h_{FE}^*	$V_{CE}=(-)5\text{V}, I_C=(-)10\text{mA}$	100*		400*	
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)10\text{mA}$		150		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(2.5)		pF
				2.0		
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)30\text{mA}, I_B=(-)3\text{mA}$		(0.14)(0.4)		V
				0.08 0.3		
Turn-ON Time	t_{on}	at specified test circuit		0.1		μsec
Storage Time	t_{stg}	"		0.2		μsec
Fall Time	t_f	"		1.0		μsec

* The 2SA1207/2SC2909 are classified by 10mA h_{FE} as follows:

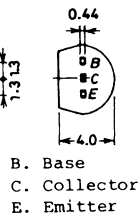
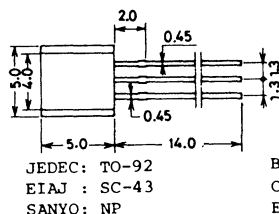
100	R	200	140	S	280	200	T	400
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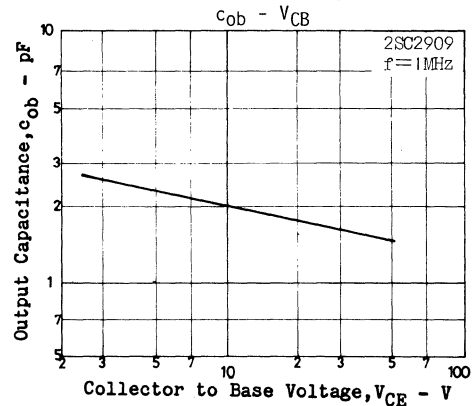
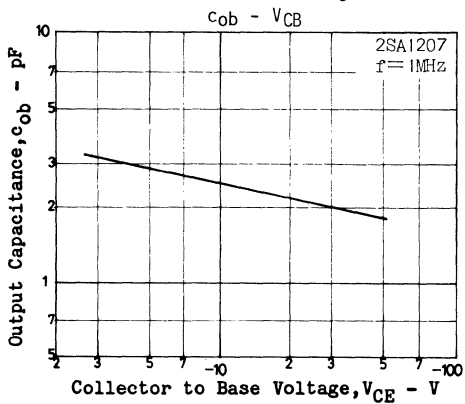
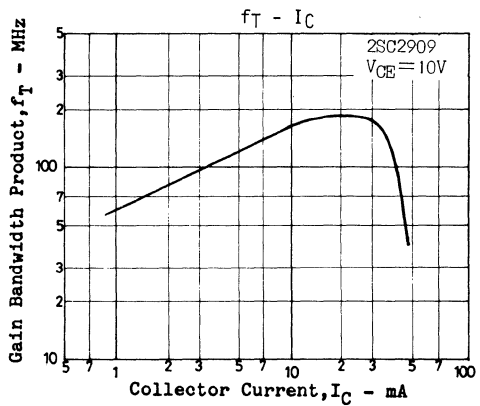
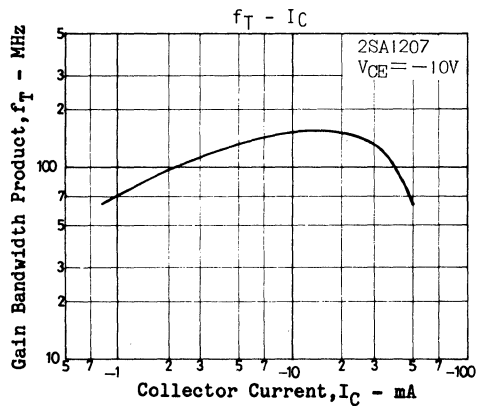
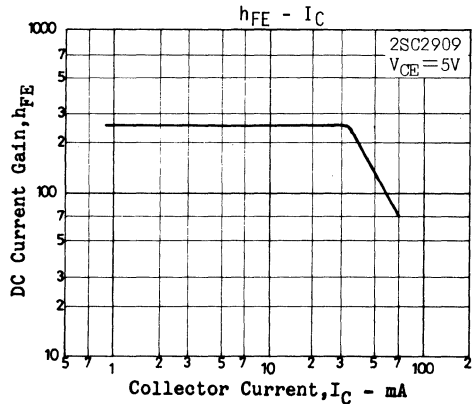
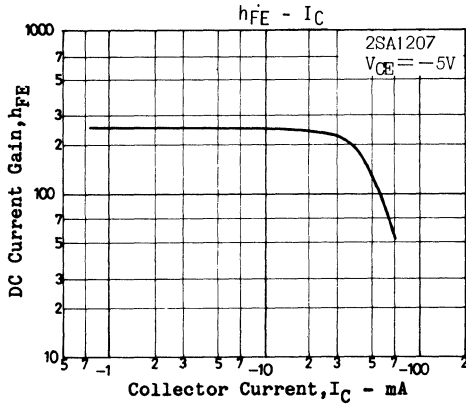
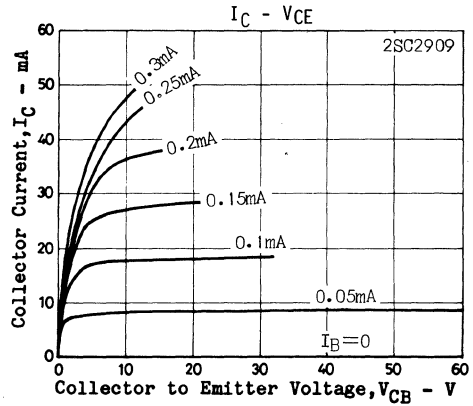
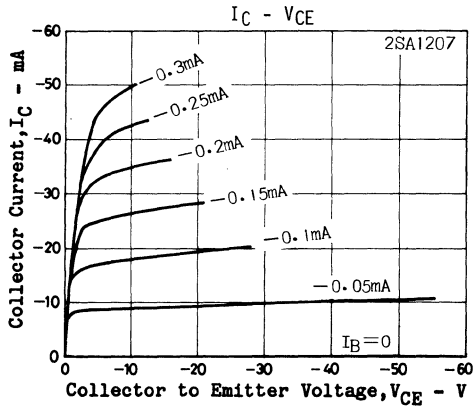
Switching Time Test Circuit

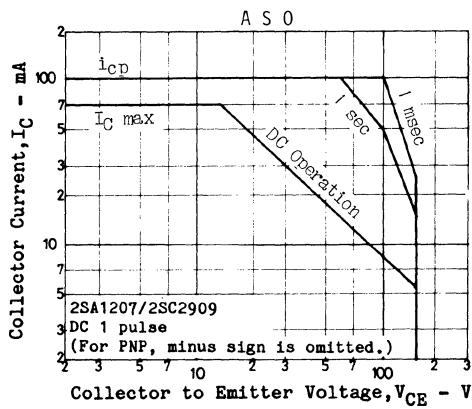
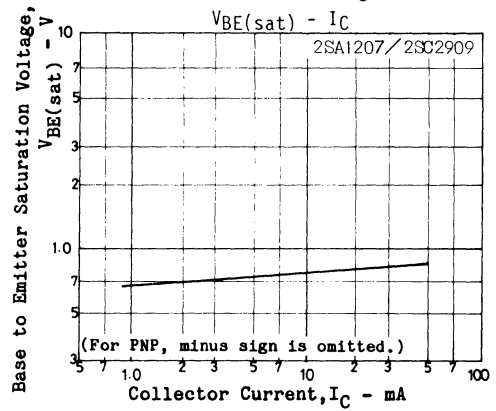
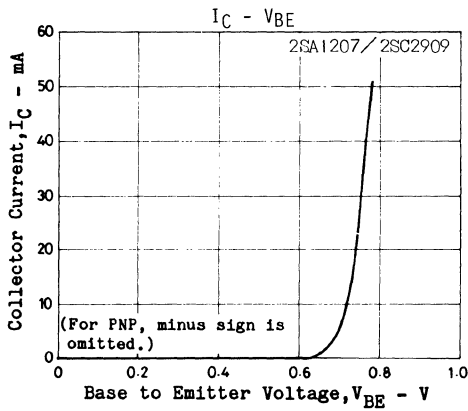
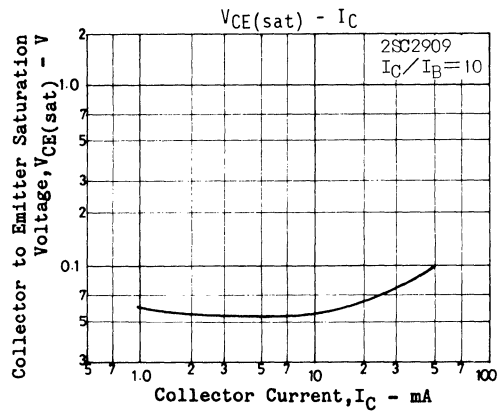
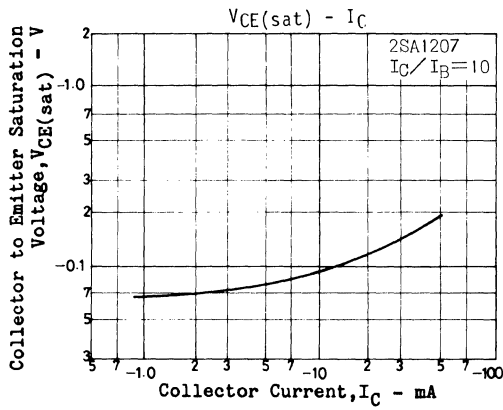


Case Outline 2003A

(unit:mm)







2SC2910



2006A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1208

High Voltage Switching, AF 80W Predriver Applications

Ⓔ781C

Features

- FBET series
- High breakdown voltage
- Good linearity of h_{FE} and small c_{ob}
- Fast switching speed

(): 2SA1208

Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Collector to base voltage	V_{CBO}	(-)180	V
Collector to emitter voltage	V_{CEO}	(-)160	V
Emitter to base voltage	V_{EBO}	(-)5	V
Collector current	I_C	(-)70	mA
Peak collector current	i_{cp}	(-)140	mA
Collector dissipation	P_C	900	mW
Junction temperature	T_j	150	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ~ 150	$^\circ\text{C}$

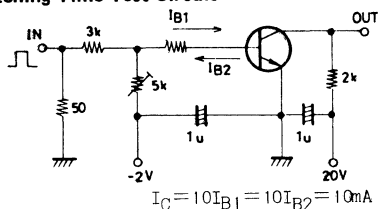
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = (-)80\text{ V}, I_E = 0$			(-)0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = (-)4\text{ V}, I_C = 0$			(-)0.1	μA
Common emitter DC current gain	h_{FE}^*	$V_{CE} = (-)5\text{ V}, I_C = (-)10\text{ mA}$	100*		400*	
Gain band-width product	f_T	$V_{CE} = (-)10\text{ V}, I_C = (-)10\text{ mA}$		150		MHz
Common base output capacitance	c_{ob}	$V_{CB} = (-)10\text{ V}, f = 1\text{ MHz}$		(2.5) 2.0		pF
Collector to emitter saturation voltage $V_{CE(sat)}$		$I_C = (-)30\text{ mA}, I_B = (-)3\text{ mA}$		(-0.14) (-0.4)		V
				0.08 0.3		
Turn-on time	t_{on}	At specified test circuit		0.1		μsec
Fall time	t_f	At specified test circuit		0.2		μsec
Storage time	t_{stg}	At specified test circuit		1.0		μsec

*: The 2SA1208/2SC2910 are classified by 10 mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400
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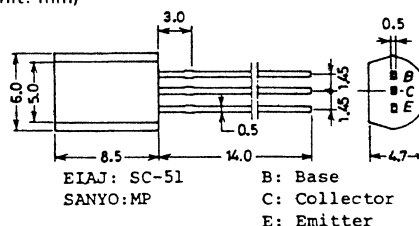
Switching Time Test Circuit

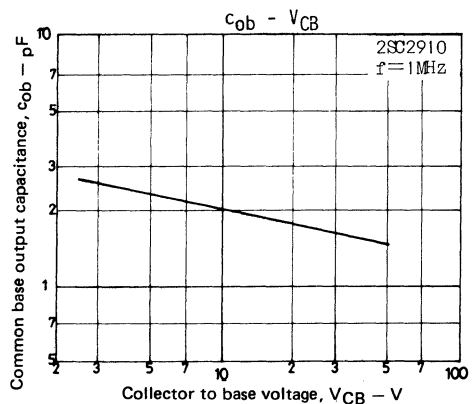
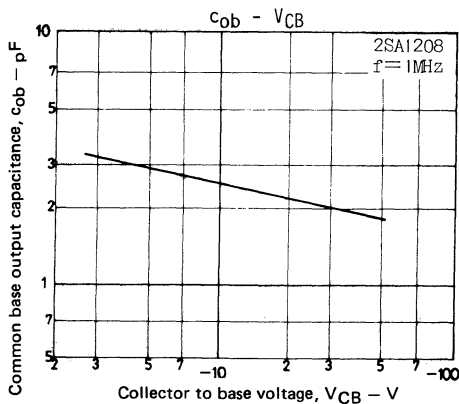
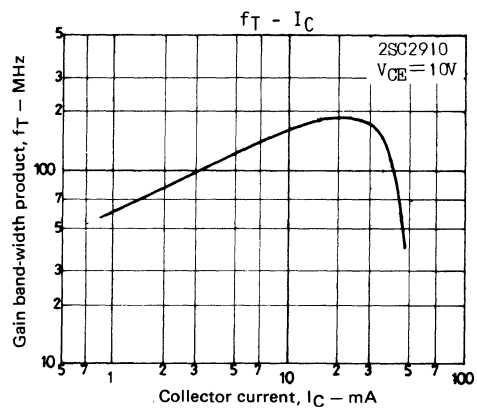
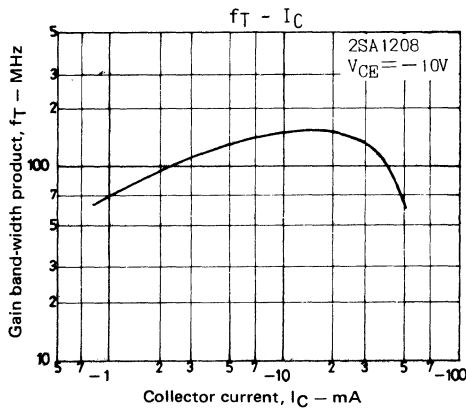
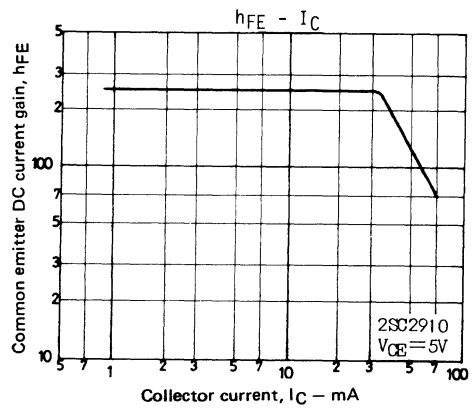
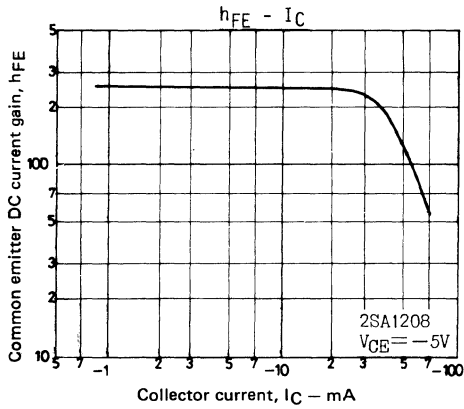
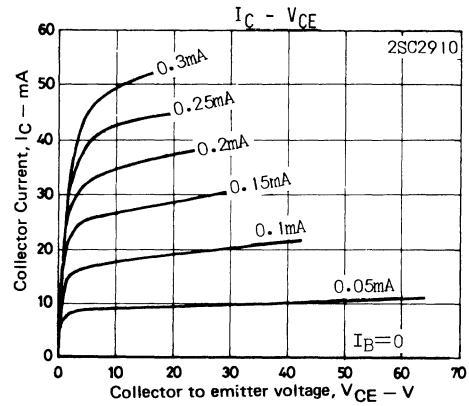
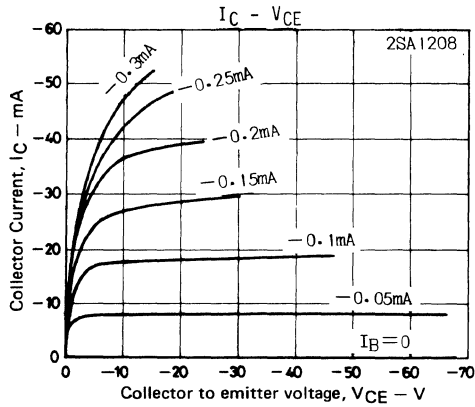


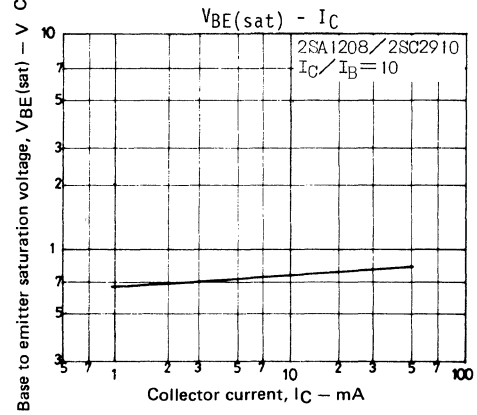
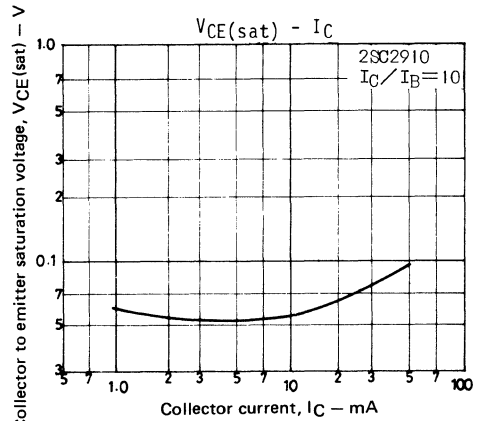
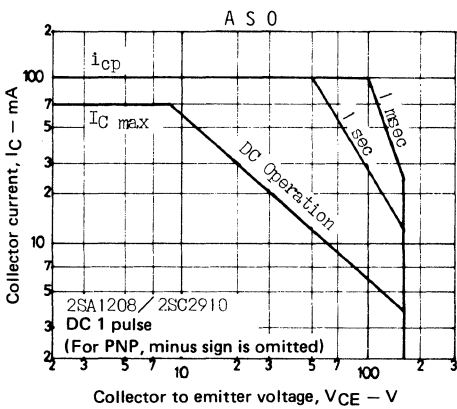
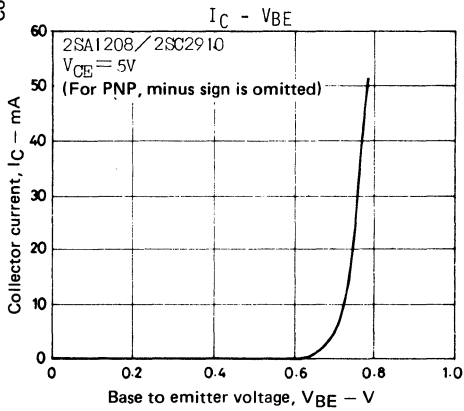
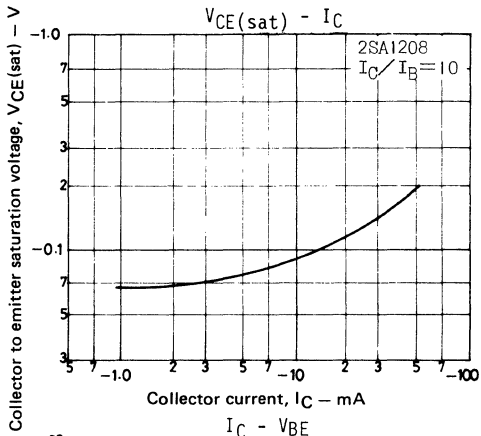
(For PNP, polarity is inverted.)

Case Outline 2006A

(unit: mm)







2SC2911



2009

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1209

High Voltage Switching, AF 100W Predriver Applications

©779B

Features

- Adoption of FBET process
- High breakdown voltage
- Good linearity of h_{FE} and small c_{ob}
- Fast switching speed

(): 2SA1209

Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Collector to base voltage	V_{CBO}	(-)180	V
Collector to emitter voltage	V_{CEO}	(-)160	V
Emitter to base voltage	V_{EBO}	(-)5	V
Collector current	I_C	(-)140	mA
Peak collector current	i_{cp}	(-)200	mA
Collector dissipation	P_C	1	W
		10	W
Junction temperature	T_j	150	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ~ +150	$^\circ\text{C}$

$T_c = 25^\circ\text{C}$

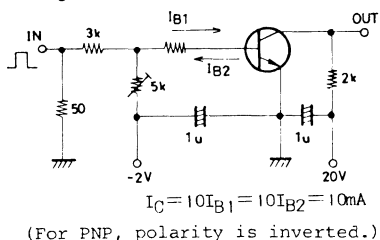
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = (-)80, I_E = 0$			(-)0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = (-)4 \text{ V}, I_C = 0$			(-)0.1	μA
Common emitter DC current gain	h_{FE}^*	$V_{CE} = (-)5 \text{ V}, I_C = (-) 10 \text{ mA}$	100*		400*	
Gain band-width product	f_T	$V_{CE} = (-)10 \text{ V}, I_C = (-) 10 \text{ mA}$		150		MHz
Common base output capacitance	c_{ob}	$V_{CB} = (-)10 \text{ V}, f = 1 \text{ MHz}$		(4.0)		pF
				3.0		
Collector to emitter saturation voltage $V_{CE(sat)}$		$I_C = (-)50 \text{ mA}, I_B = (-)5 \text{ mA}$	(-0.14)	(-0.4)		V
			0.07	0.3		
Turn-on time	T_{on}	At specified test circuit		0.1		μs
Storage time	t_{stg}	At specified test circuit		1.5		μs
Fall time	t_f	At specified test circuit		0.1		μs

*: The 2SA1209/2SC2911 are classified by 10 mA h_{FE} as follows:

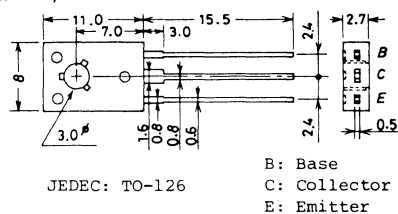
100	R	200	140	S	280	200	T	400
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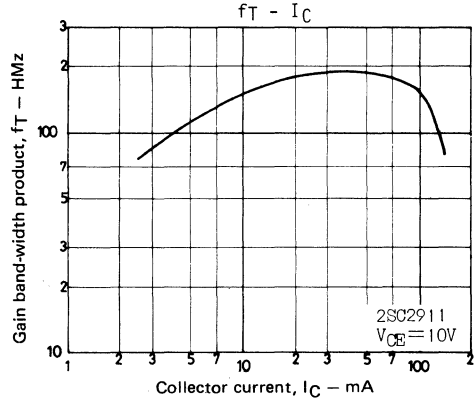
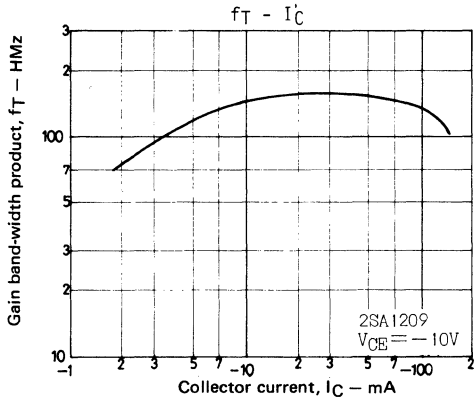
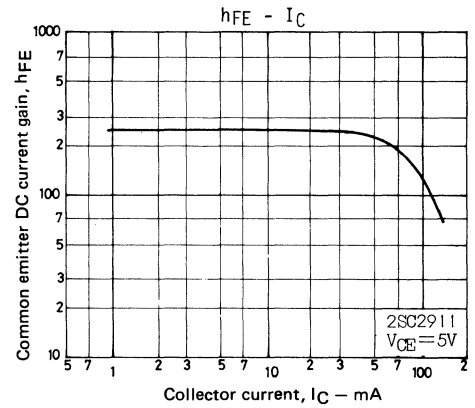
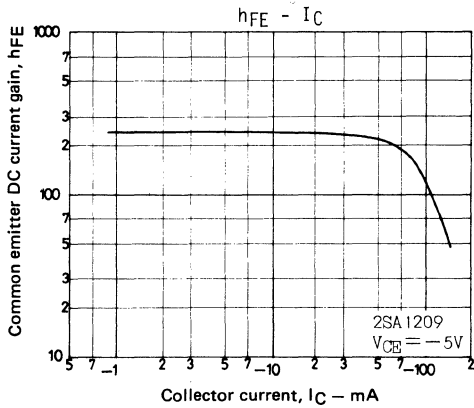
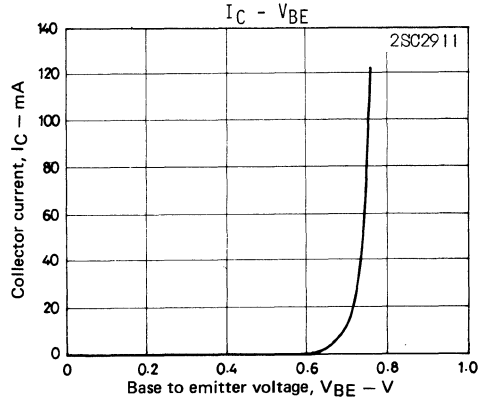
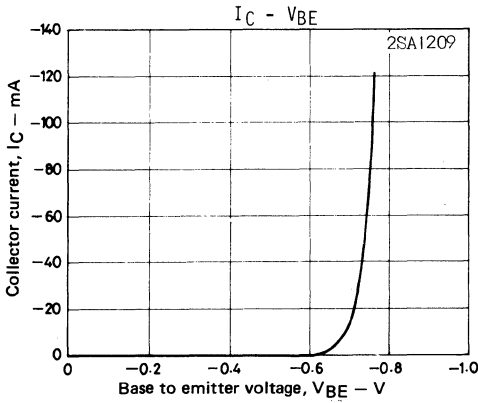
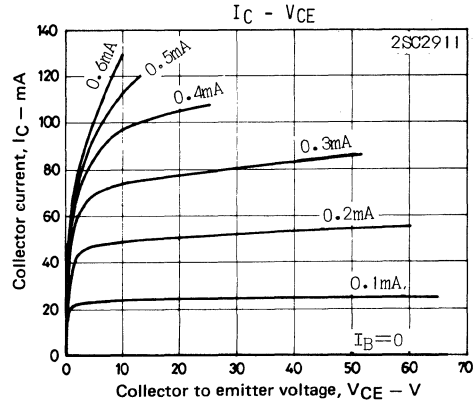
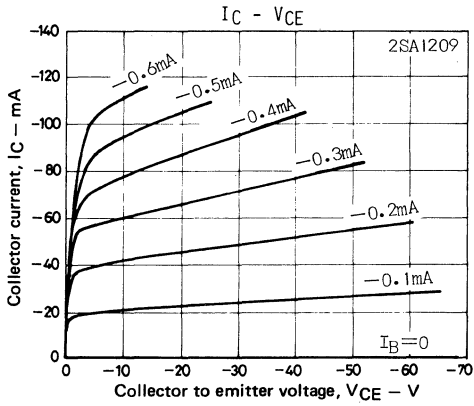
Switching Time Test Circuit

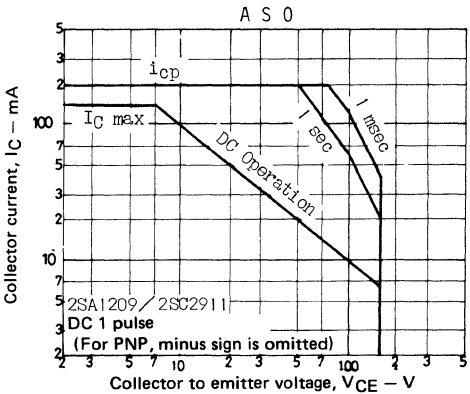
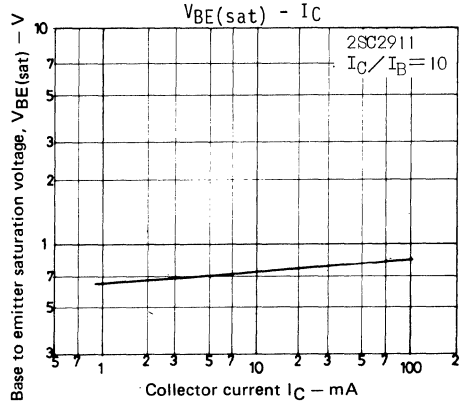
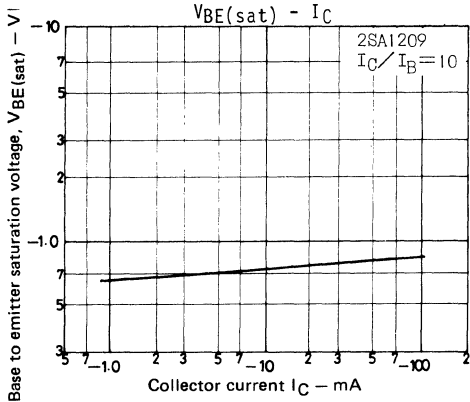
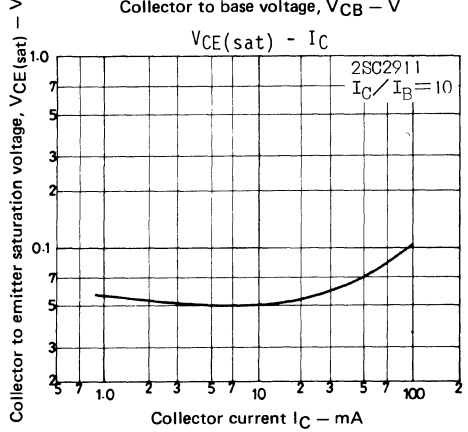
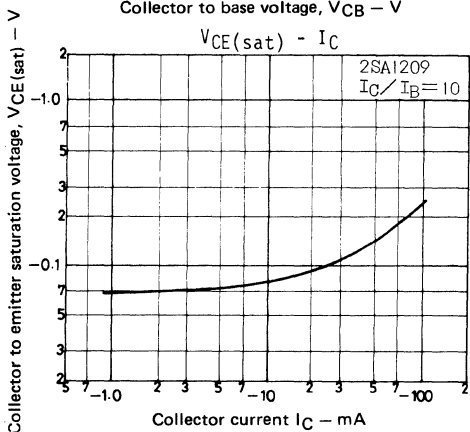
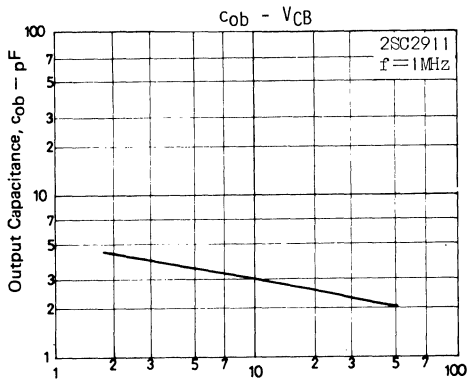
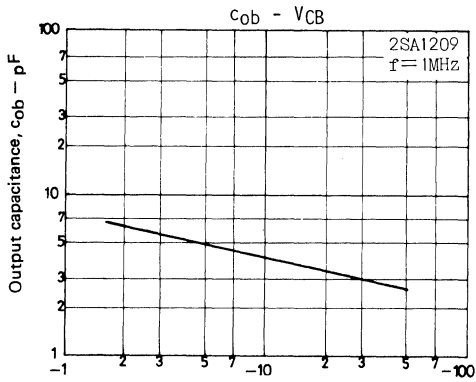


Case Outline 2009

(unit: mm)







2SC2912



2009

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1210

High Voltage Switching, AF 150W Predriver Applications

©780B

Features

- Adoption of FBET process
- High breakdown voltage
- Good linearity of h_{FE} and small c_{ob}
- Fast switching speed

(): 2SA1210

Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Collector to base voltage	V_{CBO}	(-)200	V
Collector to emitter voltage	V_{CEO}	(-)200	V
Emitter to base voltage	V_{EBO}	(-)5	V
Collector current	I_C	(-)140	mA
Peak collector current	i_{cp}	(-)200	mA
Collector dissipation	P_C	1	W
		10	W
Junction temperature	T_j	150	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ~ +150	$^\circ\text{C}$

$T_c = 25^\circ\text{C}$

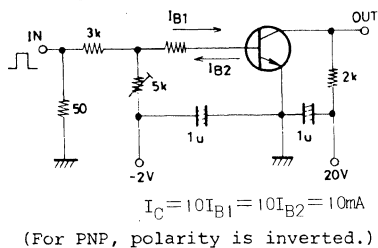
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = (-)160, I_E = 0$			(-)0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = (-)4 \text{ V}, I_C = 0$			(-)0.1	μA
Common emitter DC current gain	h_{FE}^*	$V_{CE} = (-)5 \text{ V}, I_C = (-) 10 \text{ mA}$	100*		400*	
Gain band-width product	f_T	$V_{CE} = (-)10 \text{ V}, I_C = (-) 10 \text{ mA}$		150		MHz
Common base output capacitance	c_{ob}	$V_{CB} = (-)10 \text{ V}, f = 1 \text{ MHz}$		(4.0)		pF
				3.0		
Collector to emitter saturation voltage $V_{CE(sat)}$		$I_C = (-)50 \text{ mA}, I_B = (-)5 \text{ mA}$	(-0.14)	(-0.4)		V
			0.07	0.3		
Turn-on time	T_{on}	At specified test circuit		0.1		μs
Storage time	t_{stg}	At specified test circuit		1.5		μs
Fall time	t_f	At specified test circuit		0.1		μs

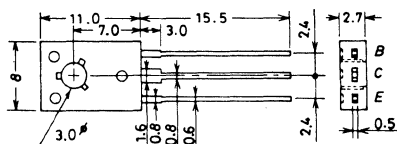
*: The 2SA1210/2SC2912 are classified by 10 mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400
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Switching Time Test Circuit

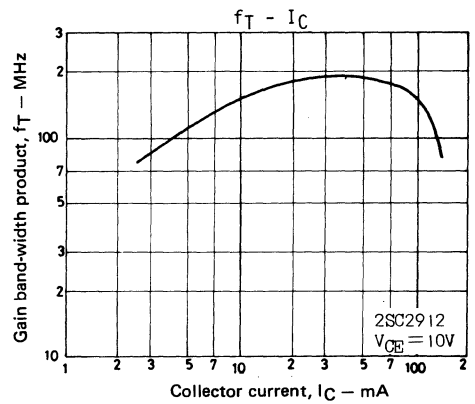
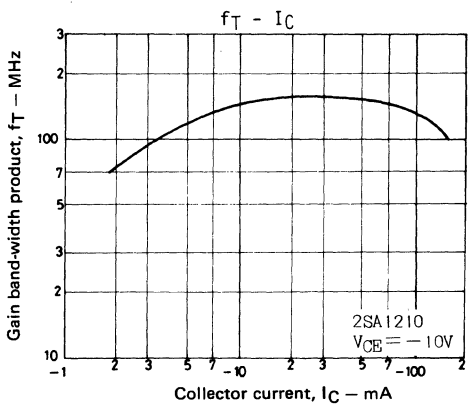
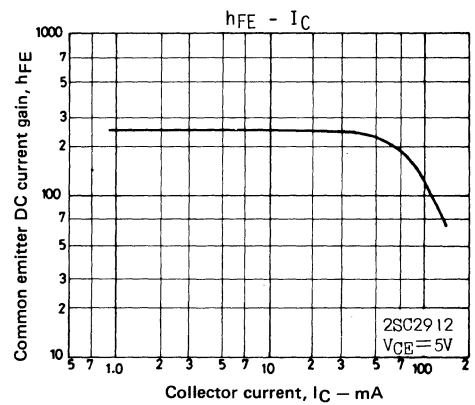
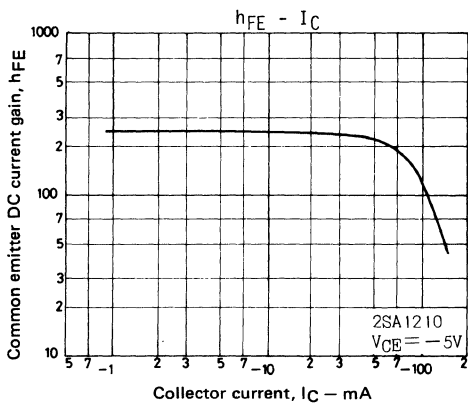
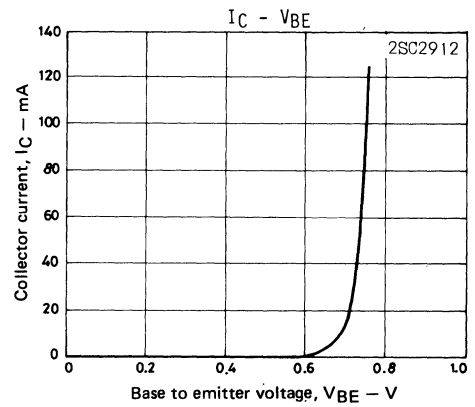
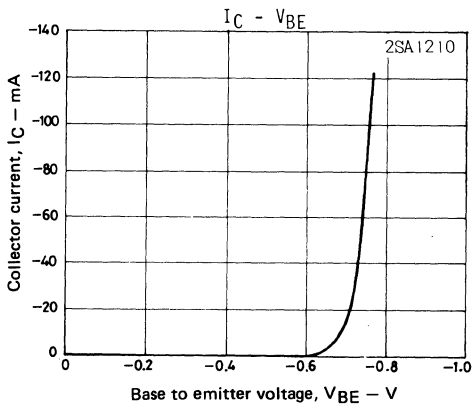
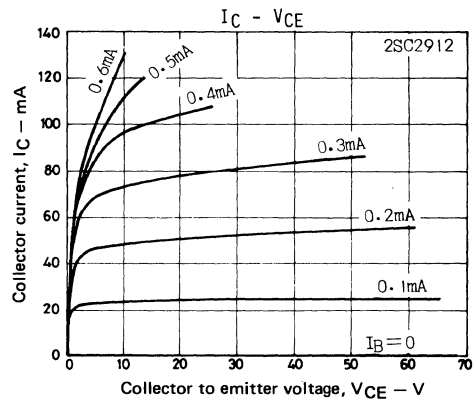
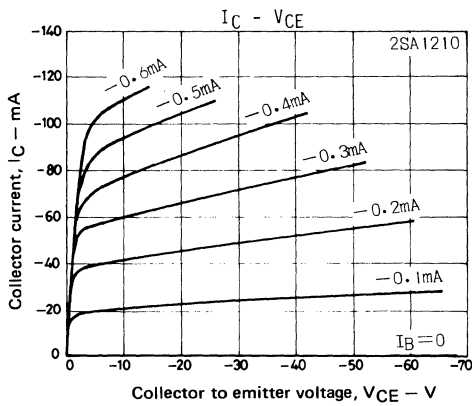


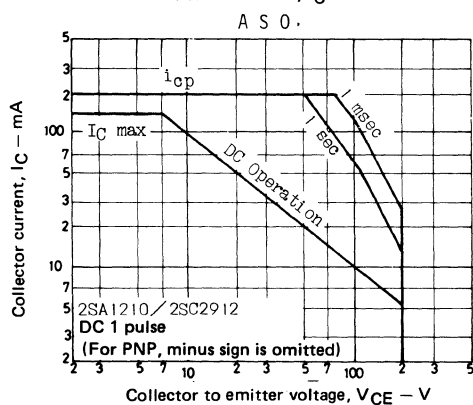
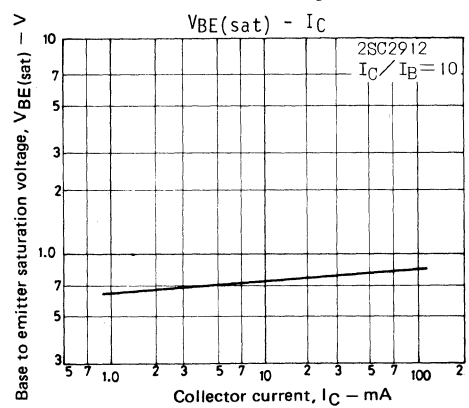
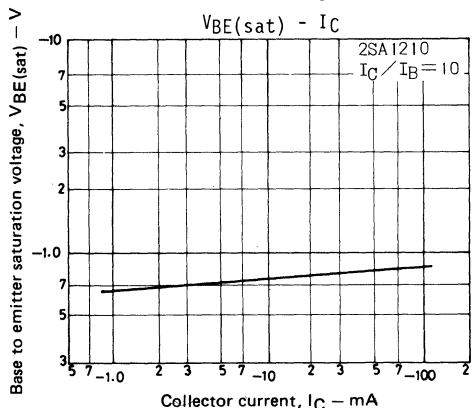
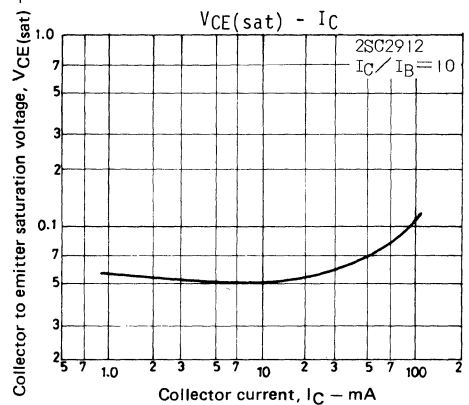
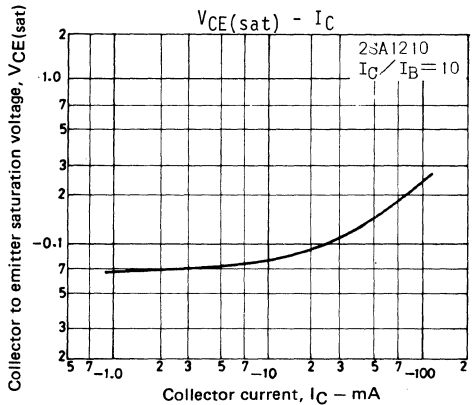
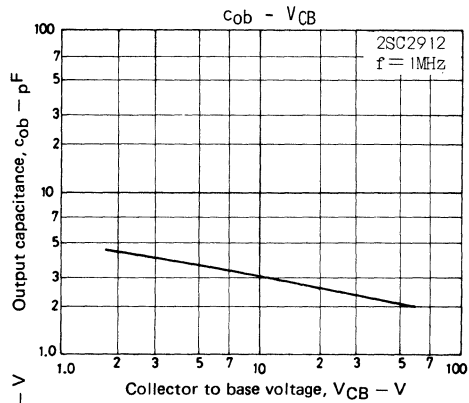
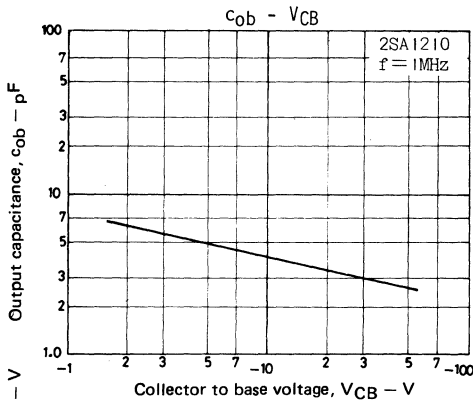
Case Outline 2009 (unit: mm)



JEDEC: TO-126

B: Base
C: Collector
E: Emitter





2SC2960



2000B

NPN Epitaxial Planar
Silicon Transistor

High Speed Switching Applications

©829F

Features

- . Fast switching speed.
- . High breakdown voltage.

Absolute Maximum Ratings at Ta=25°C

		unit
Collector to Base Voltage	V_{CB0}	60 V
Collector to Emitter Voltage	V_{CEO}	50 V
Emitter to Base Voltage	V_{EBO}	5 V
Collector Current	I_C	150 mA
Peak Collector Current	i_{cp}	400 mA
Collector Dissipation	P_C	250 mW
Junction Temperature	T_J	150 °C
Storage Temperature	T_{stg}	-55 to +150 °C

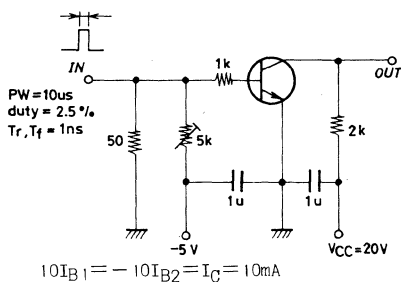
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=40V, I_E=0$			0.1	uA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4V, I_C=0$			0.1	uA
DC Current Gain	h_{FE}	$V_{CE}=6V, I_C=1mA$	100		560	
Gain Bandwidth Product	f_T	$V_{CE}=6V, I_C=1mA$		100		MHz
Output Capacitance	c_{ob}	$V_{CB}=6V, f=1MHz$		2.7		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=10mA, I_B=1mA$		0.1	0.4	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=10mA, I_B=1mA$		0.75	1.1	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10uA, I_E=0$	60			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, R_{BE}=\infty$	50			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10uA, I_C=0$	5			V
Delay Time	t_d	At specified Test Circuit		40	60	ns
Rise Time	t_r	" "		80	130	ns
Storage Time	t_{stg}	" "		230	450	ns
Fall Time	t_f	" "		160	250	ns

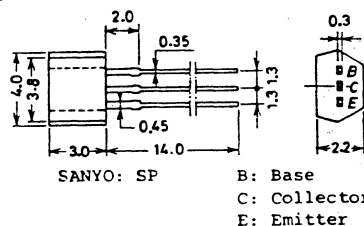
* The 2SC2960 is classified by h_{FE} at 1mA.

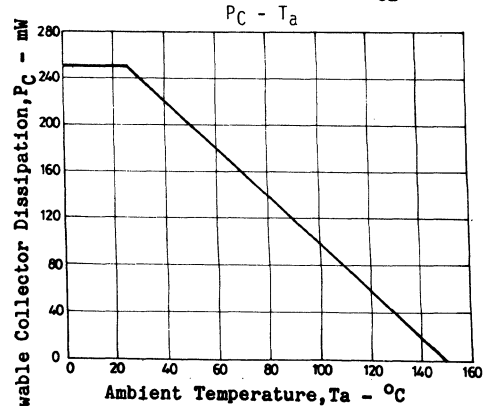
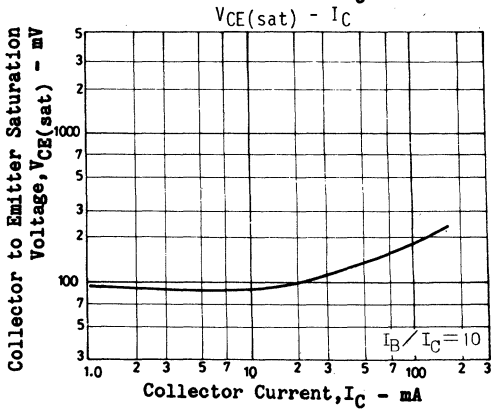
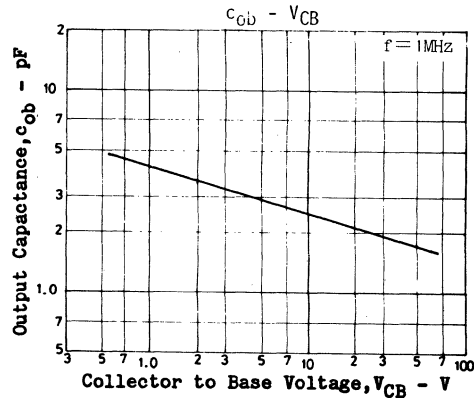
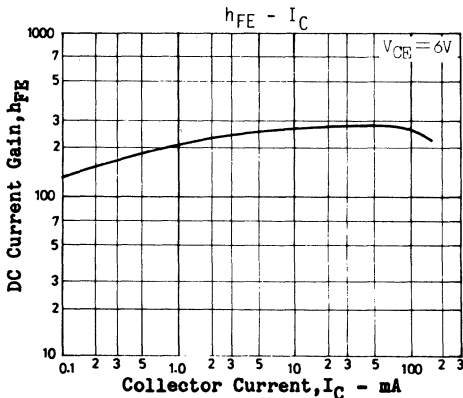
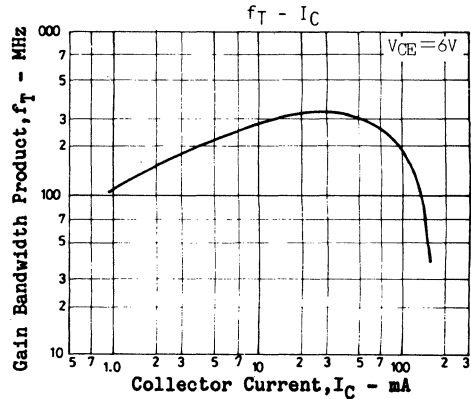
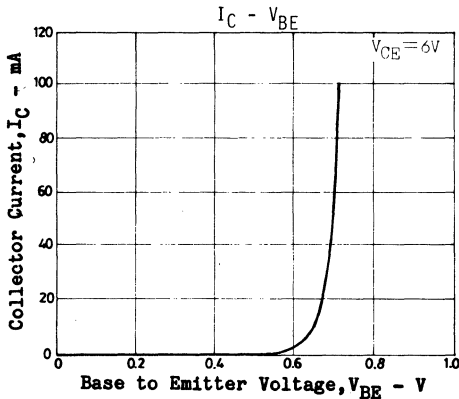
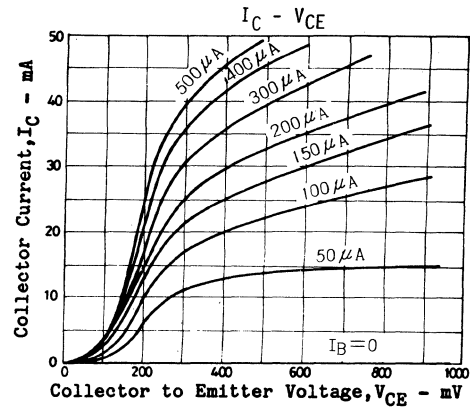
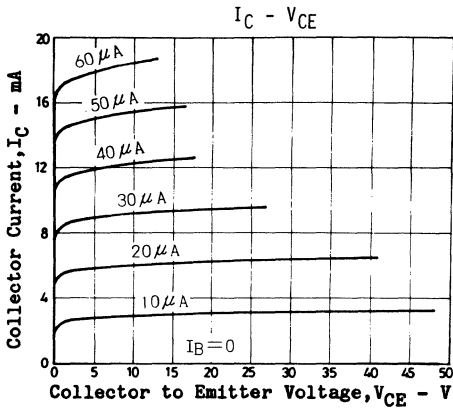
100	E	200	160	F	320	280	G	560
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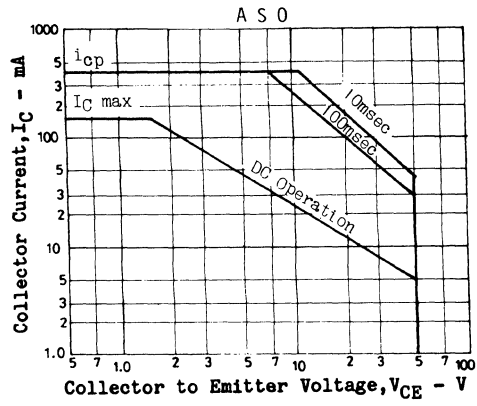
Switching Time Test Circuit



Case Outline 2000B (unit:mm)







2SC2998



2003A

NPN Epitaxial Planar
Silicon Transistor

High Speed Switching Applications

©922A

Features

- . Fast switching speed.
- . High breakdown voltage.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	60	V
Collector to Emitter Voltage	V_{CE0}	50	V
Emitter to Base Voltage	V_{EB0}	5	V
Collector Current	I_C	150	mA
Peak Collector Current	i_{cp}	400	mA
Collector Dissipation	P_C	500	mW
Junction Temperature	T_J	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

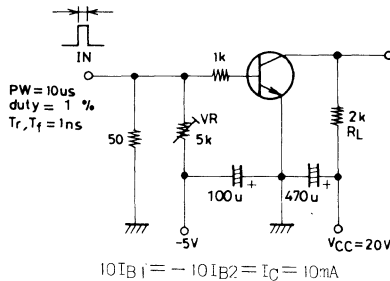
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=40\text{V}, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4\text{V}, I_C=0$			0.1	μA
DC Current Gain	h_{FE}^*	$V_{CE}=6\text{V}, I_C=1\text{mA}$	100*		560*	
Gain Bandwidth Product	f_T	$V_{CE}=6\text{V}, I_C=1\text{mA}$		100		MHz
Output Capacitance	c_{ob}	$V_{CB}=6\text{V}, f=1\text{MHz}$		2.7		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=10\text{mA}, I_B=1\text{mA}$		0.1	0.4	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=10\text{mA}, I_B=1\text{mA}$		0.75	1.1	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu\text{A}, I_E=0$	60			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1\text{mA}, R_{BE}=\infty$	50			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu\text{A}, I_C=0$	5			V
Delay Time	t_d	At specified Test Circuit		40	60	ns
Rise Time	t_r	" "		80	130	ns
Storage Time	t_{stg}	" "		230	450	ns
Fall Time	t_f	" "		160	250	ns

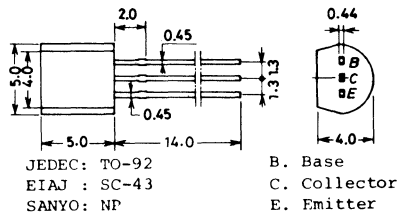
* The 2SC2998 is classified by h_{FE} at 1mA.

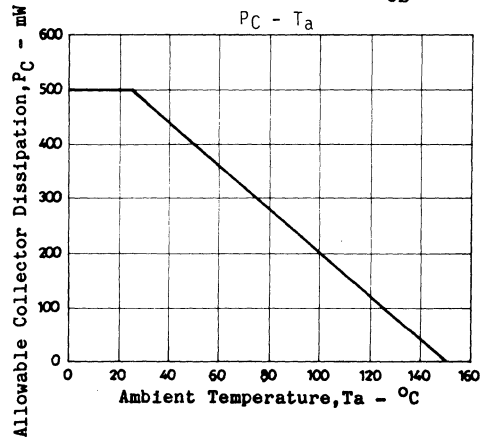
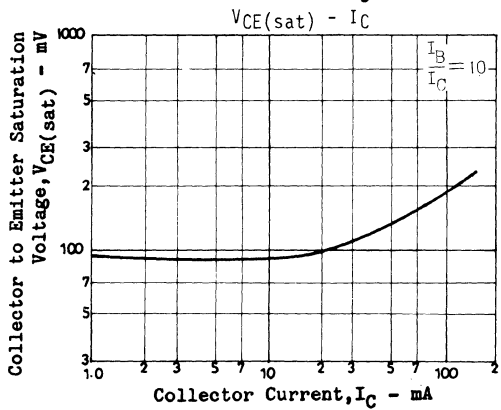
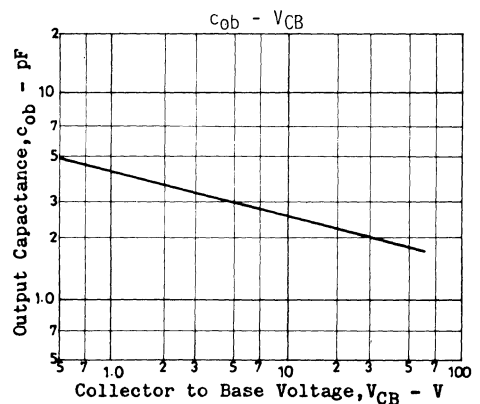
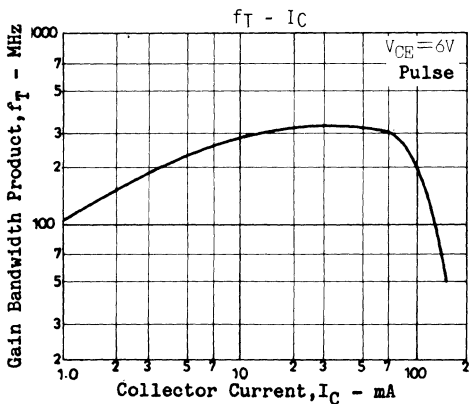
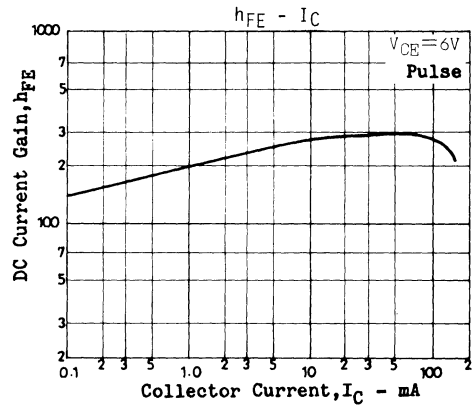
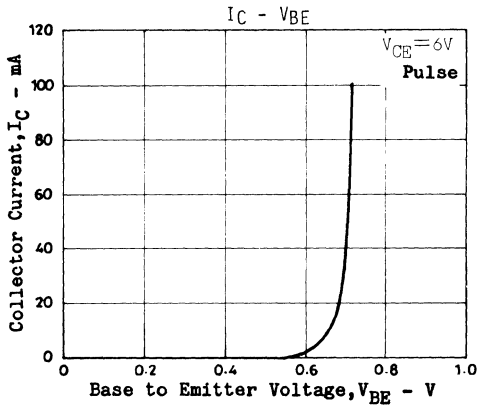
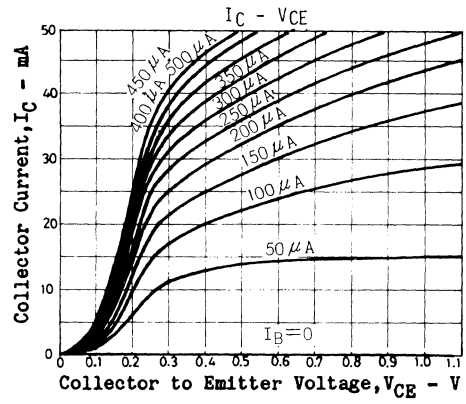
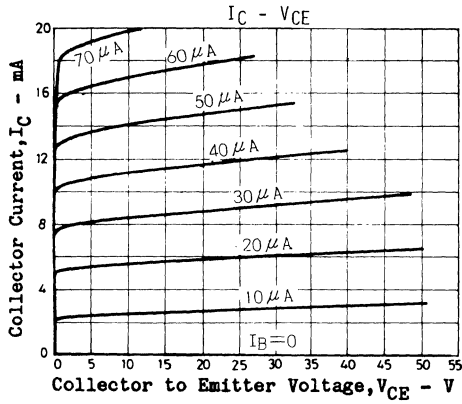
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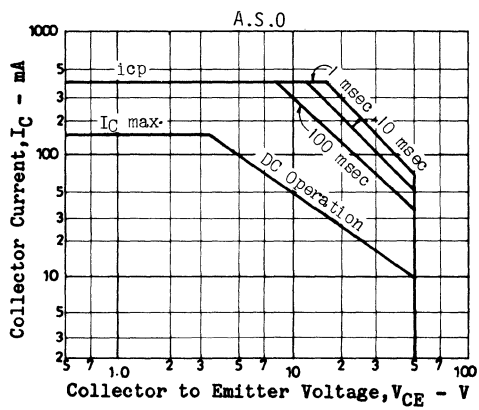
Switching Time Test Circuit



Case Outline 2003A (unit:mm)







2SC2999



2000B

NPN Epitaxial Planar
Silicon Transistor

High Frequency, General-Purpose Amp Applications

©931B

Features

- FBET Series.
- Very small-sized package permitting sets to be small-sized and slim.
- High f_T ($f_T=750\text{MHz}$ typ.) and small c_{re} ($c_{re}=0.6\text{pF}$ typ.)

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	25	V
Collector to Emitter Voltage	V_{CEO}	20	V
Emitter to Base Voltage	V_{EBO}	3	V
Collector Current	I_C	30	mA
Collector Dissipation	P_C	150	mW
Junction Temperature	T_j	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to +125	$^\circ\text{C}$

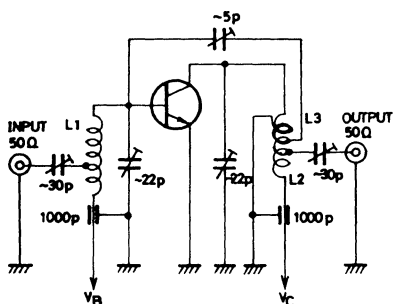
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=10\text{V}, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=3\text{V}, I_C=0$			0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=6\text{V}, I_C=1\text{mA}$	40*		200*	
Gain Bandwidth Product	f_T	$V_{CE}=6\text{V}, I_C=4\text{mA}$	450	750		MHz
Reverse Transfer Capacitance	c_{re}	$V_{CB}=6\text{V}, f=1\text{MHz}$	0.6	0.9		pF
Base to Collector Time Constant	$r_{bb}'C_c$	$V_{CB}=6\text{V}, I_C=1\text{mA}, f=31.9\text{MHz}$		19		ps
Noise Figure	NF	$V_{CE}=6\text{V}, I_C=1\text{mA}, f=100\text{MHz}$	2.2			dB
Power Gain	PG	$V_{CE}=6\text{V}, I_C=1\text{mA}, f=100\text{MHz}$	28			dB

* 2SC2999 is classified as follows according to h_{FE} at 1mA.

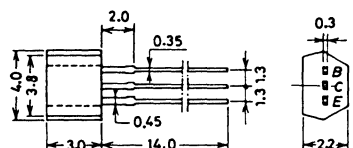
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NF, PG Test Circuit



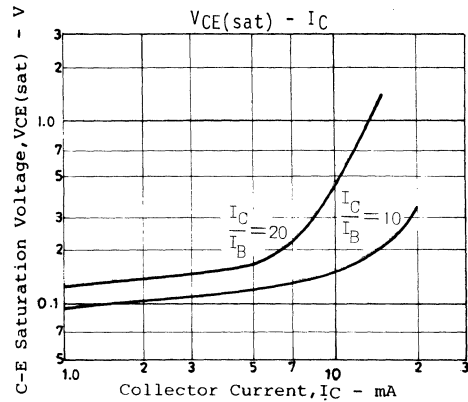
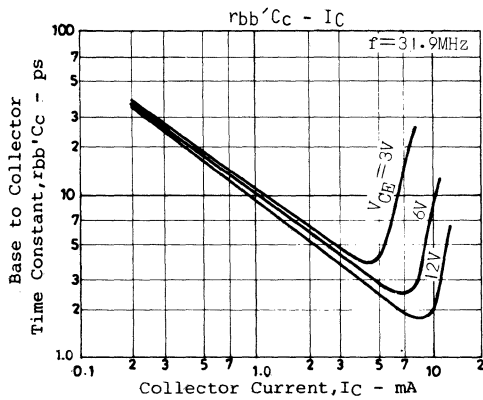
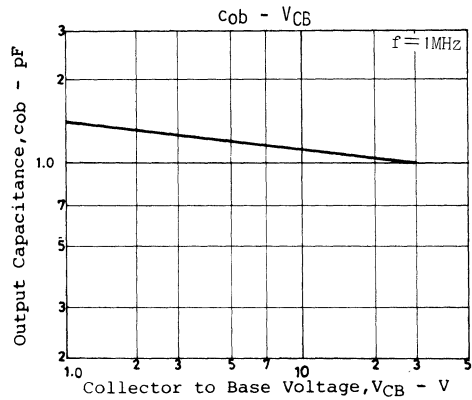
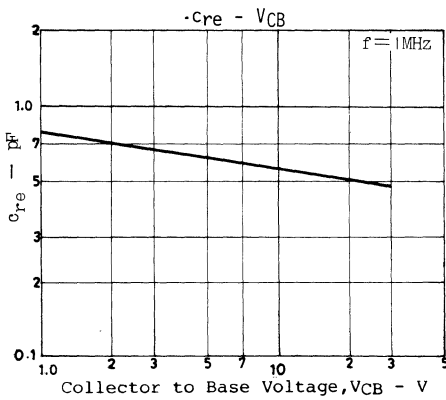
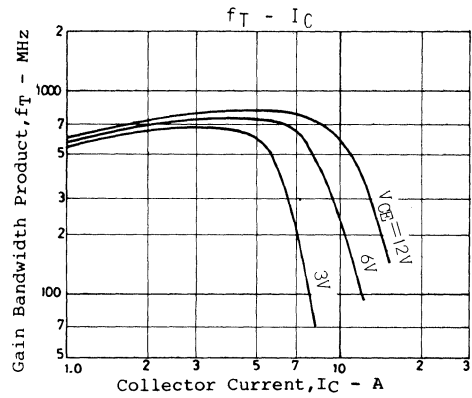
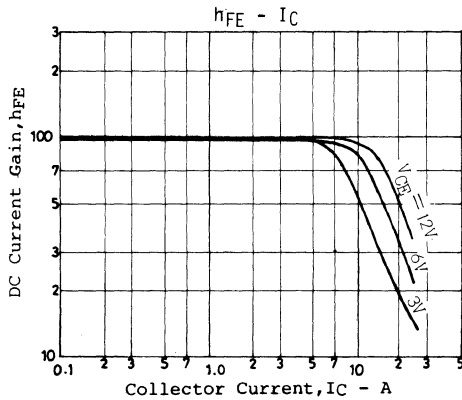
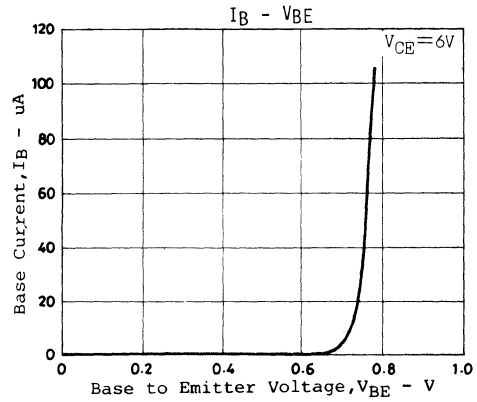
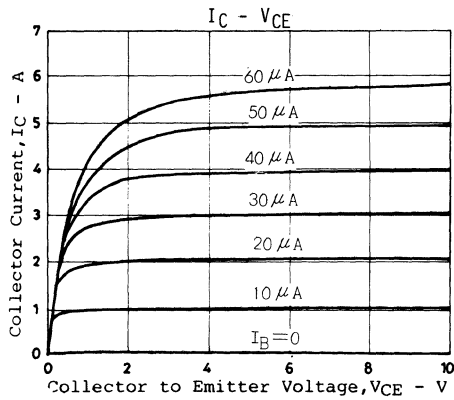
- L1: 1mm ϕ plated wire 10mm ϕ 5T pitch 15mm, tapped at 2T from base side.
 L2: 1mm ϕ plated wire 10mm ϕ 7T pitch 10mm, tapped at 2T from V_C side.
 L3: 1mm ϕ enameled wire 10mm ϕ 3T pitch 10mm.

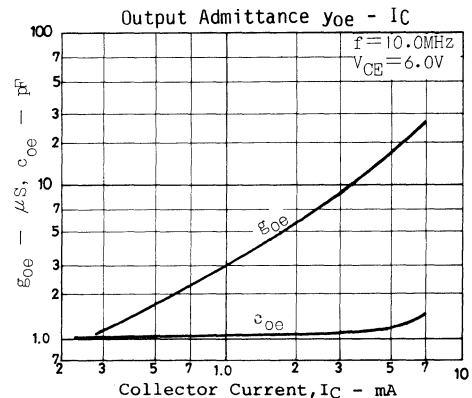
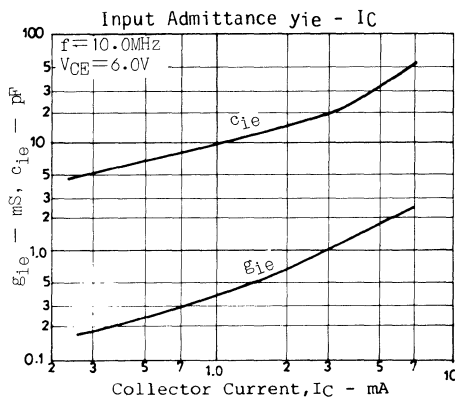
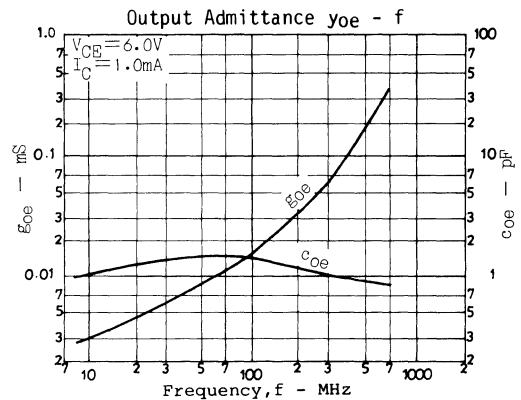
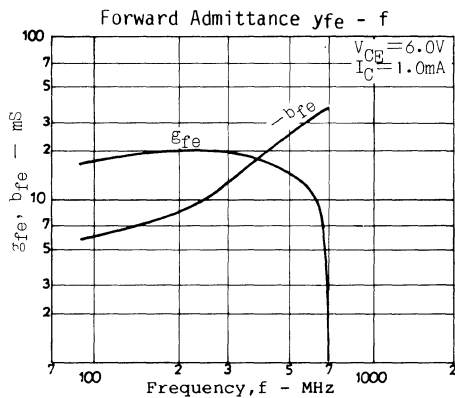
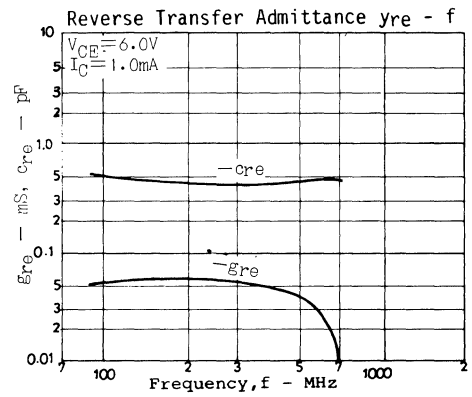
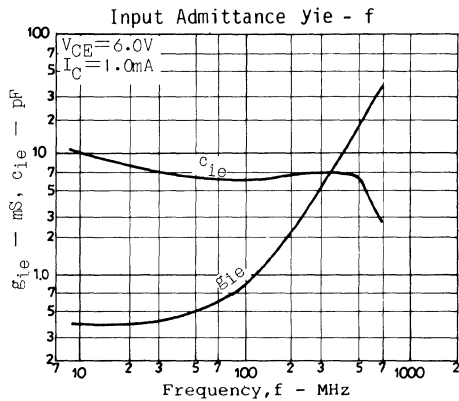
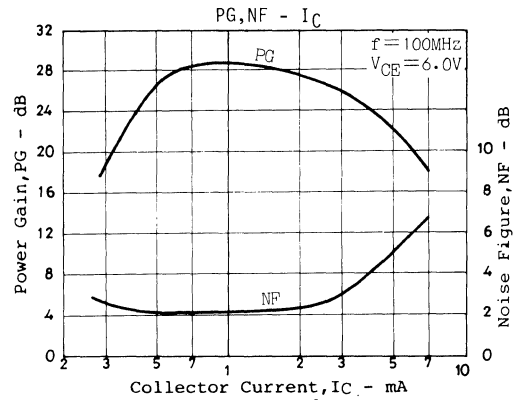
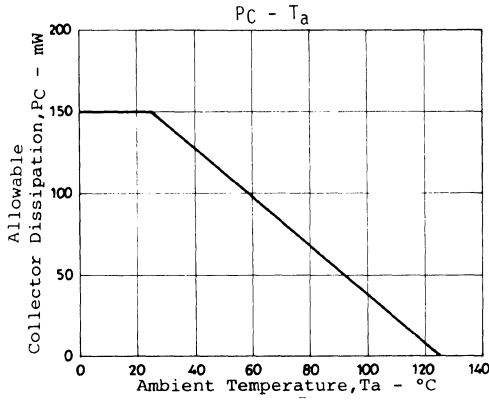
Case Outline 2000B (unit:mm)

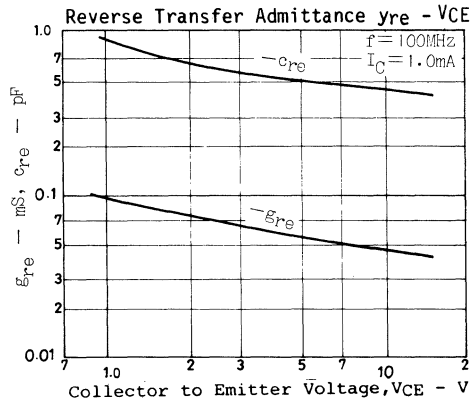
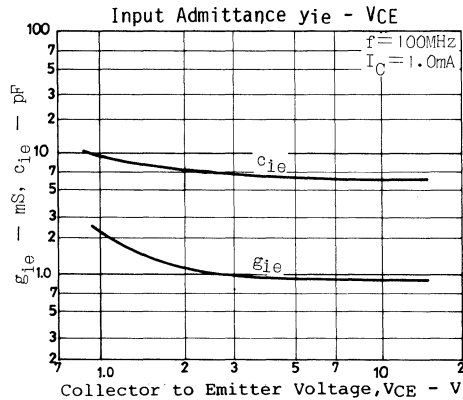
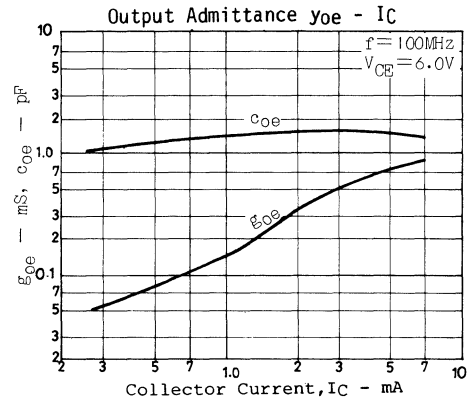
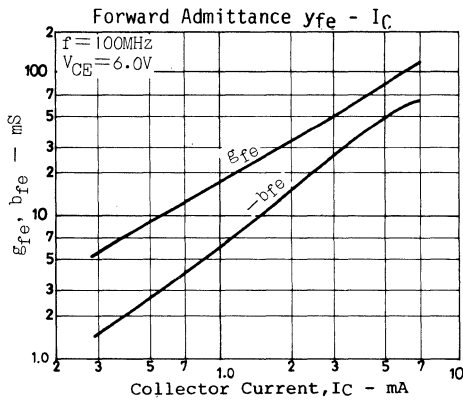
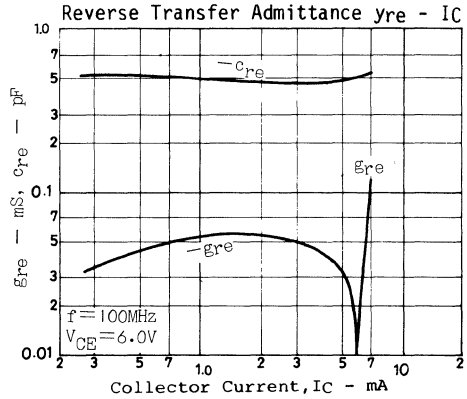
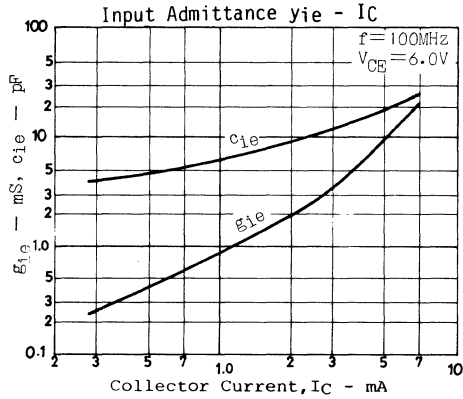
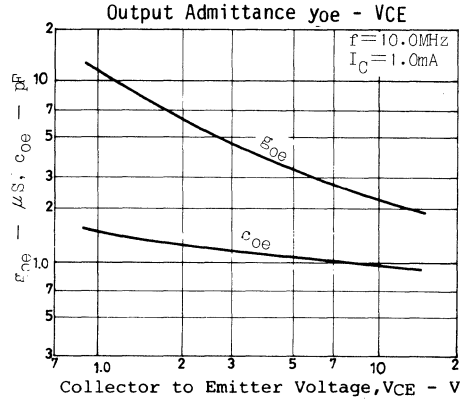
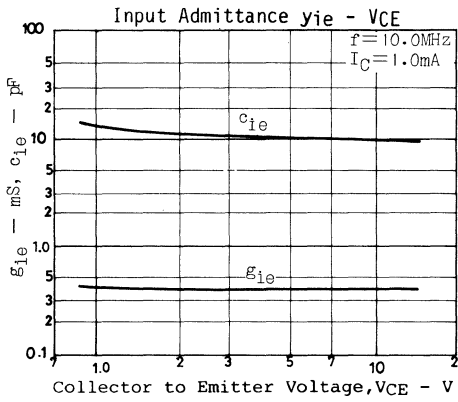


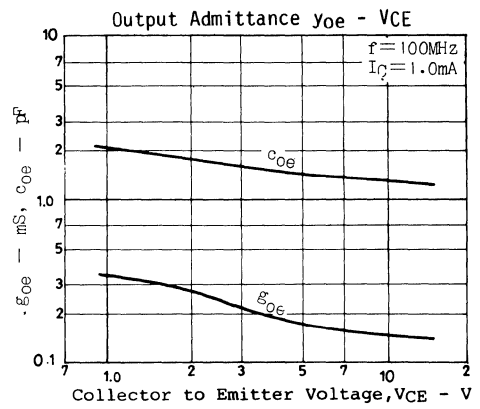
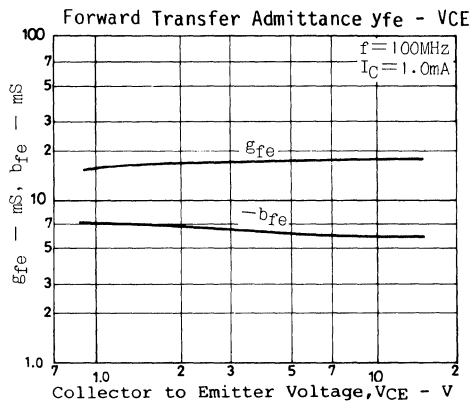
SANYO: SP

B: Base
C: Collector
E: Emitter









2SC3000



2003A

NPN Epitaxial Planar
Silicon Transistor

High Frequency, General-Purpose Amp Applications

©866B

Features

- . FBET series.
- . High f_T and small c_{re} .

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	30	V
Collector to Emitter Voltage	V_{CE0}	20	V
Emitter to Base Voltage	V_{EB0}	5	V
Collector Current	I_C	30	mA
Collector Dissipation	P_C	250	mW
Junction Temperature	T_j	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +125	$^\circ\text{C}$

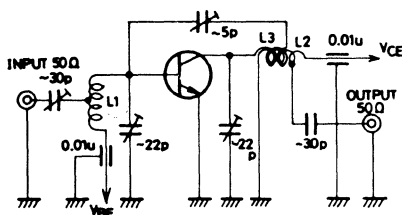
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=10\text{V}, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=4\text{V}, I_C=0$			0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=6\text{V}, I_C=1\text{mA}$	60*		320*	
Gain Bandwidth Product	f_T	$V_{CE}=6\text{V}, I_C=1\text{mA}$	200	320		MHz
Reverse Transfer Capacitance	c_{re}	$V_{CB}=6\text{V}, f=1\text{MHz}$	0.7	1.1	1.4	pF
C-B Time Constant	$r_{bb}'C_c$	$V_{CB}=6\text{V}, I_C=1\text{mA}, f=31.9\text{MHz}$		15	22	ps
Noise Figure	NF	$V_{CE}=6\text{V}, I_C=1\text{mA}, f=100\text{MHz}$		3.0		dB
Power Gain	PG	$V_{CE}=6\text{V}, I_C=1\text{mA}, f=100\text{MHz}$		25		dB

* The 2SC3000 is classified by 1mA h_{FE} as follows :

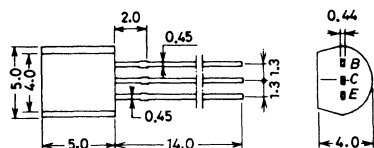
60	D	120	100	E	200	160	F	320
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NF, PC Test Circuit



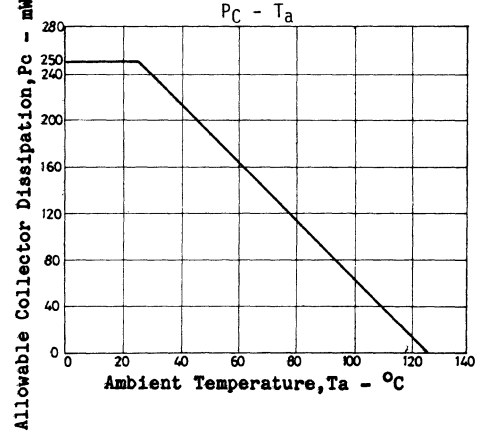
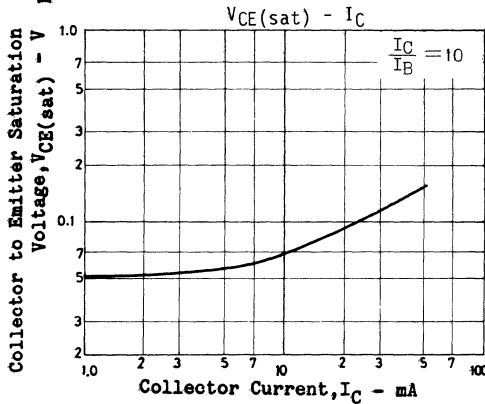
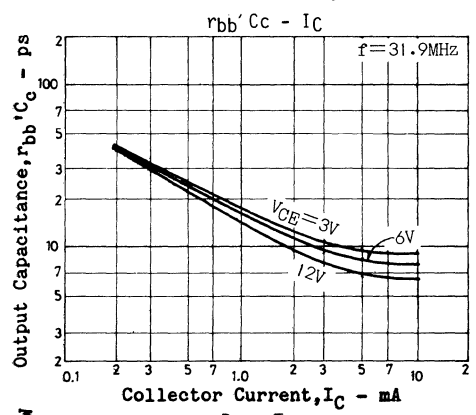
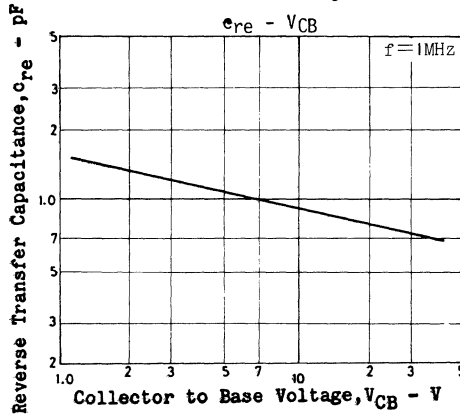
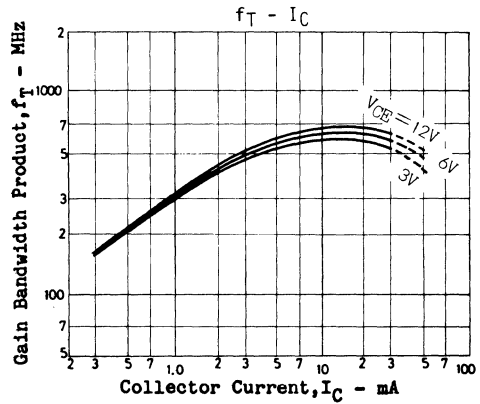
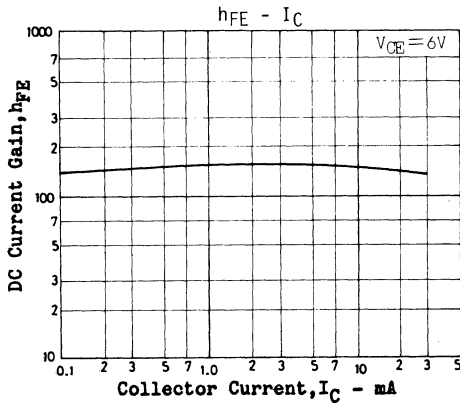
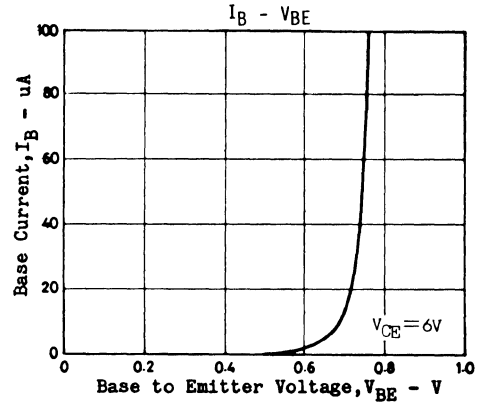
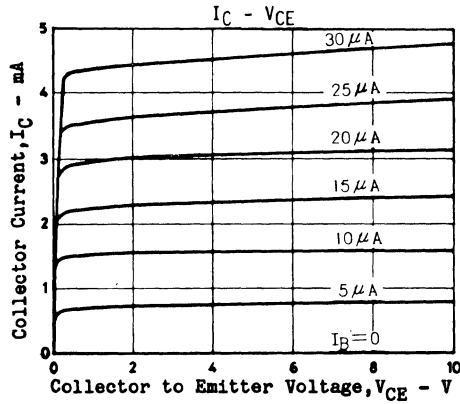
- L1: 1mm ϕ plated wire, 10mm ϕ 5T, tapped at 2T from V_{BE} .
L2: 1mm ϕ plated wire, 10mm ϕ 7T, tapped at 1T from V_{CE} .
L3: 1mm ϕ enameled wire, 10mm ϕ 3T.

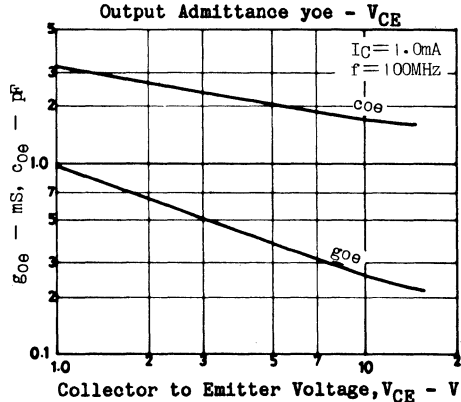
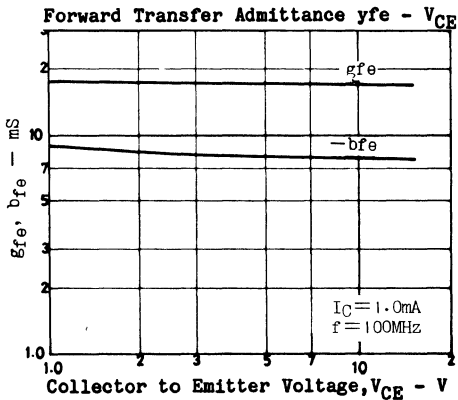
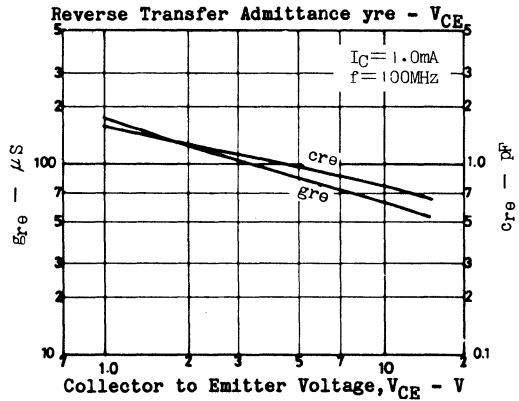
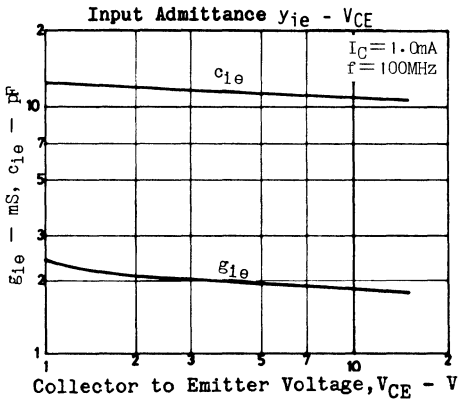
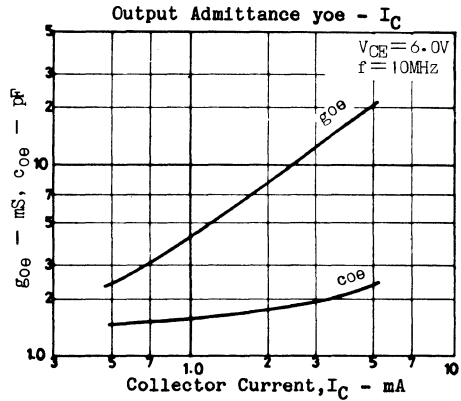
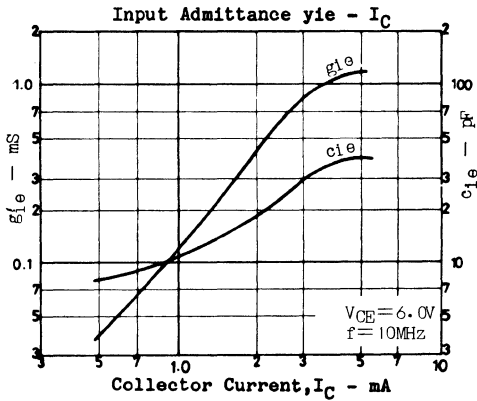
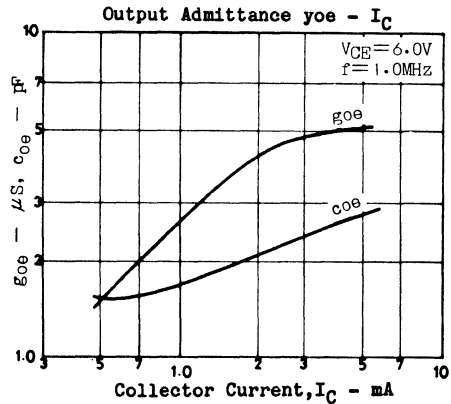
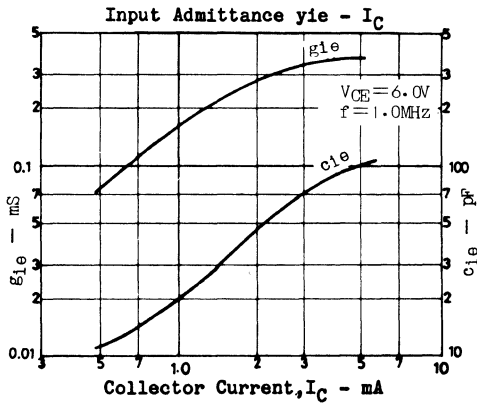
Case Outline 2003A (unit:mm)

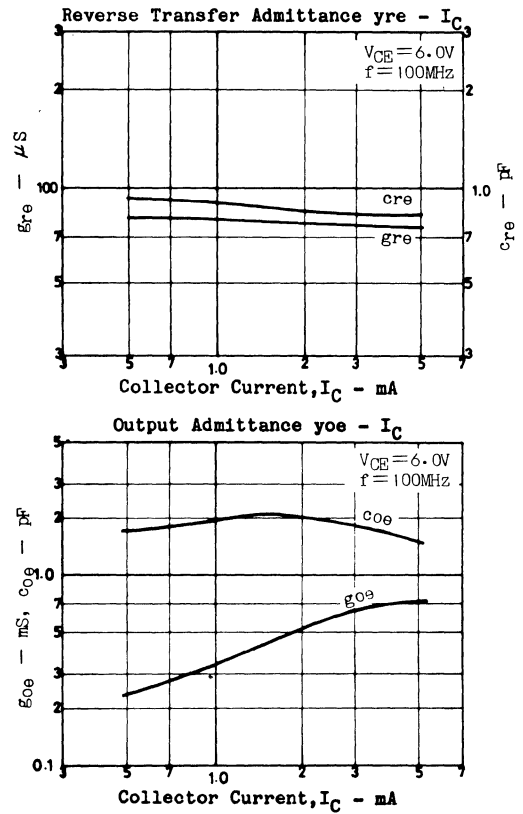
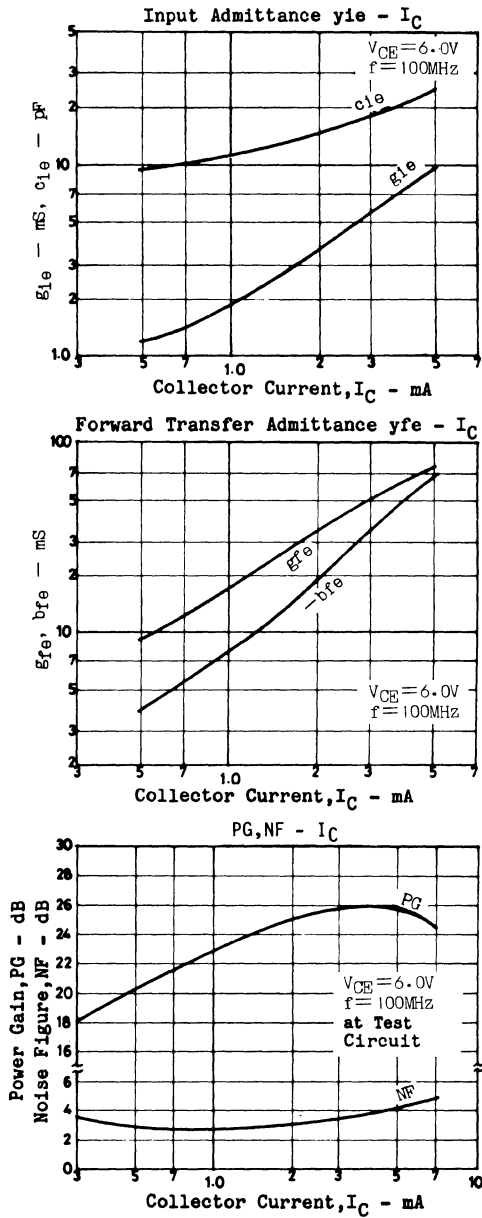


JEDEC: TO-92
EIAJ : SC-43
SANYO: NP

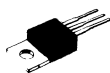
B: Base
C: Collector
E: Emitter







2SC3038



2010A

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

Ⓔ949A

Features

- High breakdown voltage($V_{CB0} \geq 500V$)
- Fast switching speed.
- Wide ASO.

Absolute Maximum Ratings at $T_a = 25^\circ C$

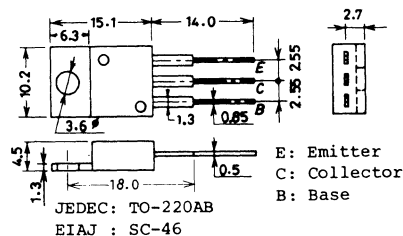
			unit
Collector to Base Voltage	V_{CB0}	500	V
Collector to Emitter Voltage	V_{CEO}	400	V
Emitter to Base Current	V_{EBO}	7	V
Collector Current	I_C	4	A
Peak Collector Current	i_{cp}	8	A
	$PW \leq 300\mu s,$ $Duty\ Cycle \leq 10\%$		
Base Current	I_B	1.5	A
Collector Dissipation	P_C	1.75	W
	$T_c = 25^\circ C$	40	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = 400V, I_E = 0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 5V, I_C = 0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = 5V, I_C = 0.4A$		15		
	$h_{FE}(2)$	$V_{CE} = 5V, I_C = 2A$		8		
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = 2A, I_B = 0.4A$			1.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = 2A, I_B = 0.4A$			1.5	V
Gain Bandwidth Product	f_T	$V_{CE} = 10V, I_C = 0.4A$		20		MHz
Output Capacitance	c_{ob}	$V_{CB} = 10V, f = 1MHz$		40		pF
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 1mA, I_E = 0$		500		V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 5mA, R_{BE} = \infty$		400		V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 1mA, I_C = 0$		7		V
C-E Sustain Voltage	$V_{CEO(sus)}$	$I_C = 4A, I_B = 0.8A, L = 50\mu H$		400		V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 4A, I_{B1} = 0.8A, L = 200\mu H,$ $I_{B2} = -0.8A, clamped$		400		V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 0.75A, I_{B1} = 0.15A, L = 200\mu H$ $I_{B2} = -0.15A, clamped$		450		V

Case Outline 2010A

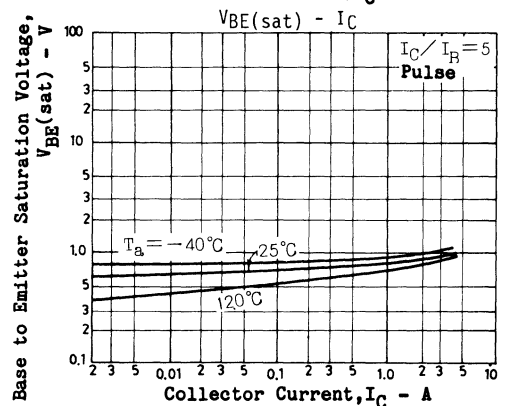
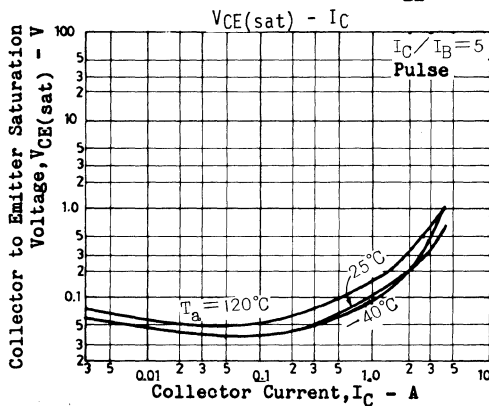
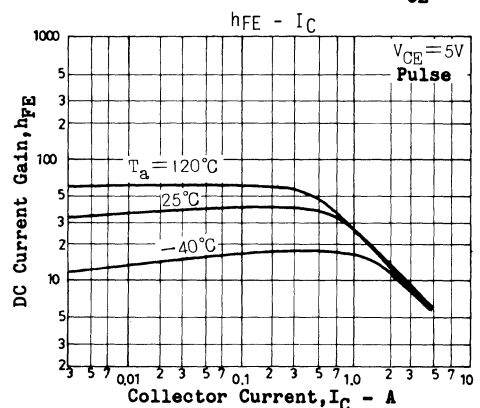
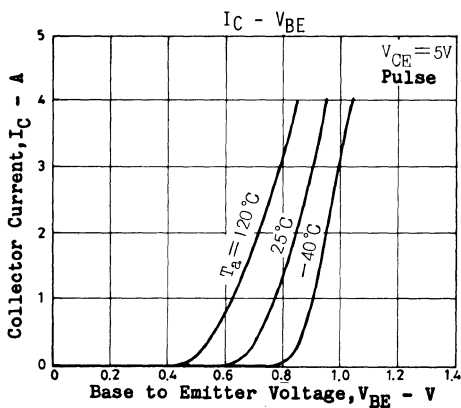
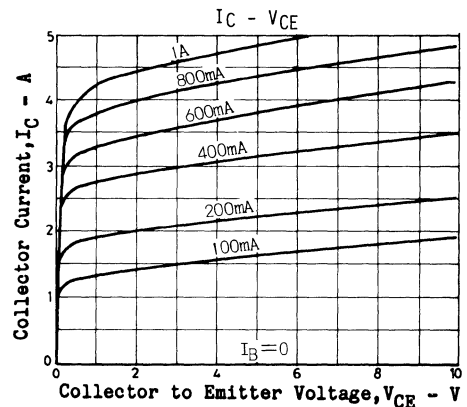
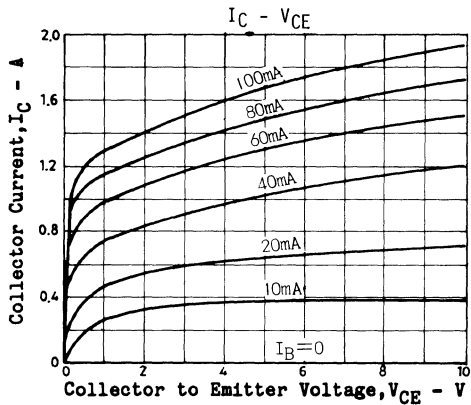
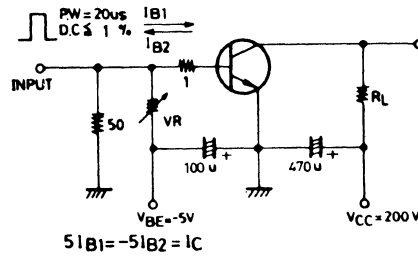
(unit:mm)

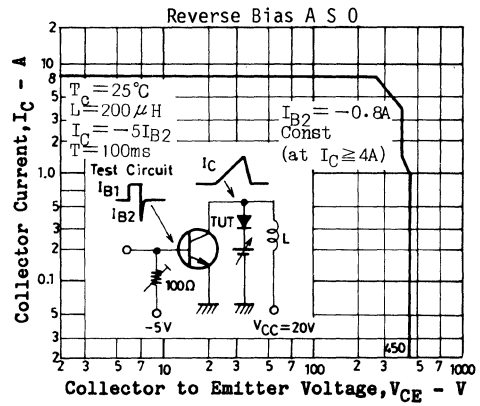
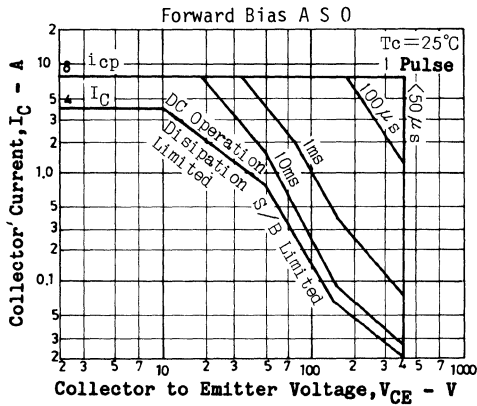
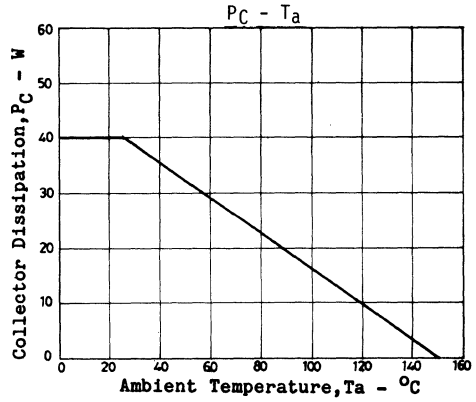
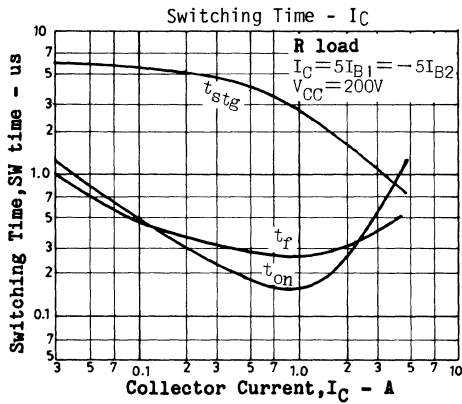


3095MY, TS No.949-1/3

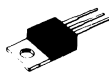
			min	typ	max	unit
Turn-ON Time	t_{on}	$I_C=3A, I_{B1}=0.6A, I_{B2}=-0.6A,$ $R_L=66.6\Omega, V_{CC}=200V$			1.0	us
Storage Time	t_{stg}	"			2.5	us
Fall Time	t_f	"			1.0	us

Switching Time Test Circuit





2SC3039



2010A

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©996A

Features

- . High breakdown voltage($V_{CB0} \geq 500V$)
- . Fast switching speed.
- . Wide ASO.

Absolute Maximum Ratings at $T_a = 25^\circ C$

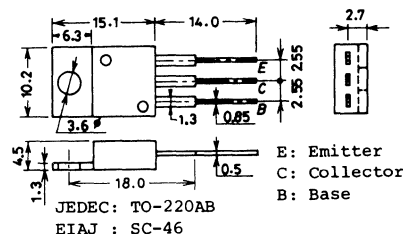
			unit
Collector to Base Voltage	V_{CB0}	500	V
Collector to Emitter Voltage	V_{CEO}	400	V
Emitter to Base Current	V_{EBO}	7	V
Collector Current	I_C	7	A
Peak Collector Current	i_{cp}	14	A
	$PW \leq 300\mu s$, Duty Cycle $\leq 10\%$		
Base Current	I_B	3	A
Collector Dissipation	P_C	1.75	W
	$T_c = 25^\circ C$	50	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = 400V, I_E = 0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 5V, I_C = 0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = 5V, I_C = 0.8A$		15		
	$h_{FE}(2)$	$V_{CE} = 5V, I_C = 4A$		8		
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = 4A, I_B = 0.8A$			1.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = 4A, I_B = 0.8A$			1.5	V
Gain Bandwidth Product	f_T	$V_{CE} = 10V, I_C = 0.8A$		20		MHz
Output Capacitance	c_{ob}	$V_{CB} = 10V, f = 1MHz$		80		pF
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C = 1mA, I_E = 0$		500		V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_C = 5mA, R_{BE} = \infty$		400		V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E = 1mA, I_C = 0$		7		V
C-E Sustain Voltage	$V_{CEO(sus)}$	$I_C = 7A, I_B = 1.4A, L = 50\mu H$		400		V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 7A, I_{B1} = 1.4A, L = 200\mu H$, $I_{B2} = -1.4A$, clamped		400		V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 1.5A, I_{B1} = 0.3A, L = 200\mu H$, $I_{B2} = -0.3A$, clamped		450		V

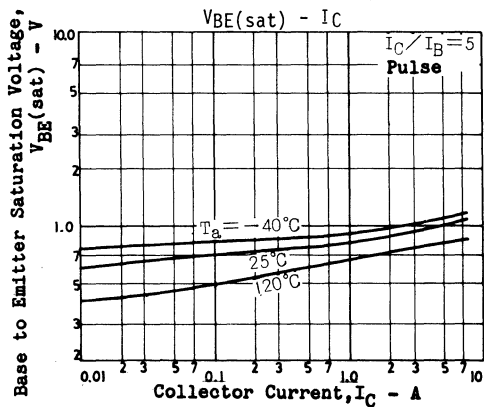
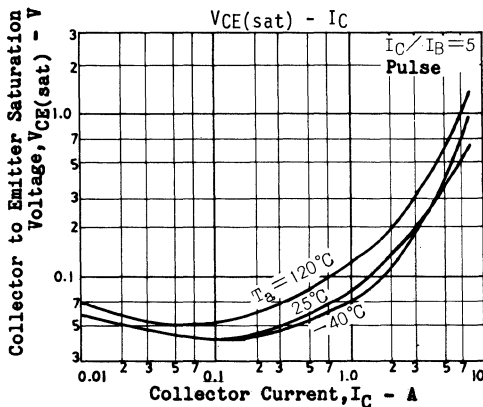
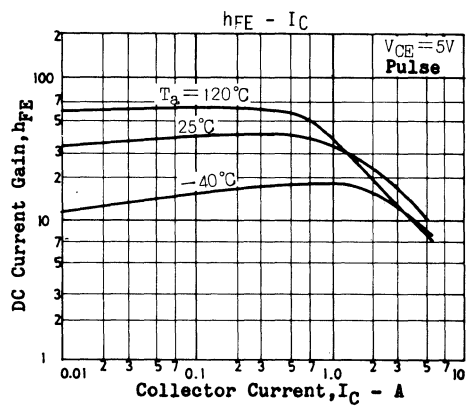
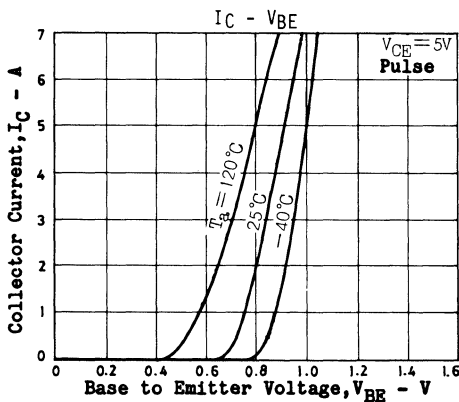
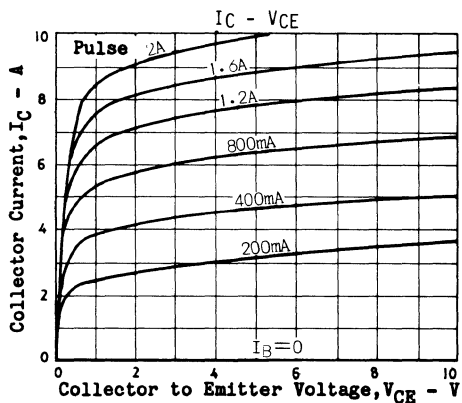
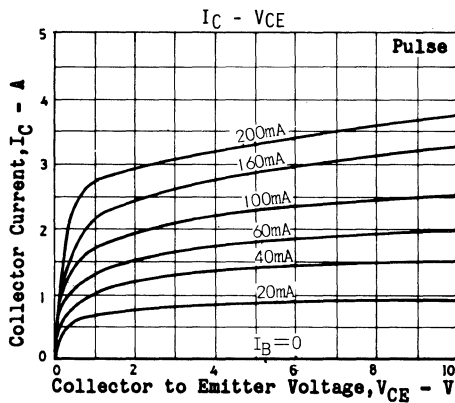
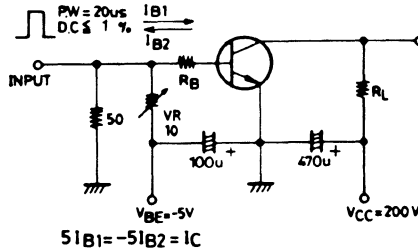
Case Outline 2010A

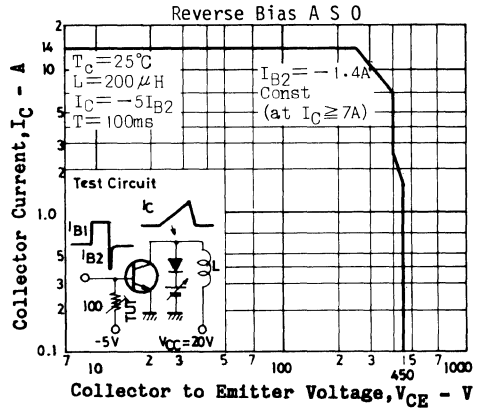
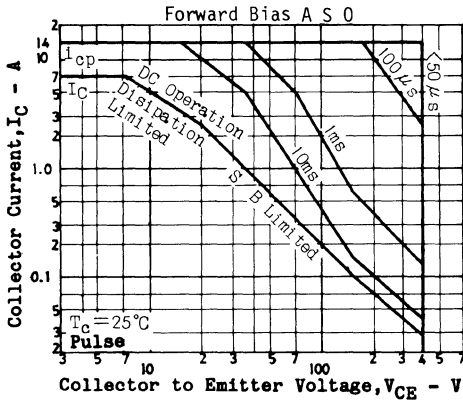
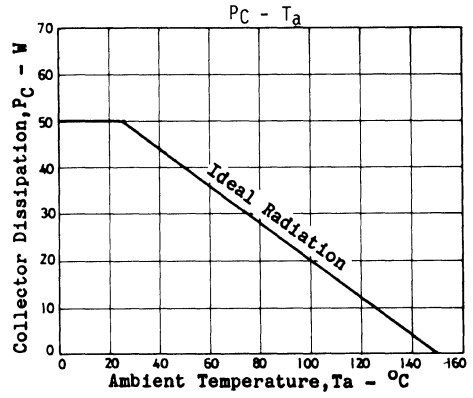
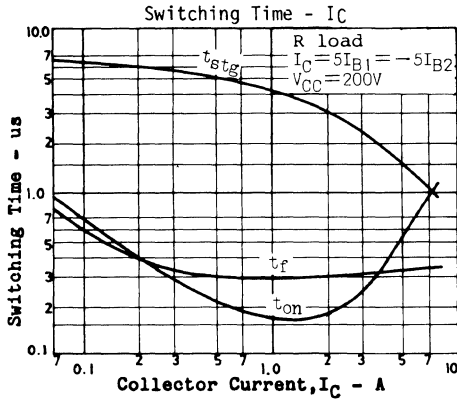
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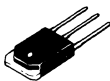
			min	typ	max	unit
Turn-ON Time	t_{on}	$I_C=5A, I_{B1}=1A, I_{B2}=-1A,$ $R_L=40\Omega, V_{CC}=200V$			1.0	us
Storage Time	t_{stg}	" "			2.5	us
Fall Time	t_f	" "			1.0	us

Switching Time Test Circuit





2SC3040



2022

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©997A

Features

- . High breakdown voltage($V_{CB0} \geq 500V$)
- . Fast switching speed.
- . Wide ASO.

Absolute Maximum Ratings at $T_a = 25^\circ C$

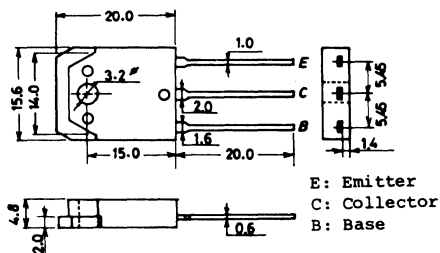
			unit
Collector to Base Voltage	V_{CB0}	500	V
Collector to Emitter Voltage	V_{CE0}	400	V
Emitter to Base Current	V_{EB0}	7	V
Collector Current	I_C	8	A
Peak Collector Current	i_{cp}	16	A
	$PW \leq 300\mu s,$		
	Duty Cycle $\leq 10\%$		
Base Current	I_B	3	A
Collector Dissipation	P_C	2.5	W
	$T_c = 25^\circ C$	80	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB} = 400V, I_E = 0$			10	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB} = 5V, I_C = 0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = 5V, I_C = 0.8A$	15			
	$h_{FE}(2)$	$V_{CE} = 5V, I_C = 4A$	8			
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = 4A, I_B = 0.8A$			1.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = 4A, I_B = 0.8A$			1.5	V
Gain Bandwidth Product	f_T	$V_{CE} = 10V, I_C = 0.8A$		20		MHz
Output Capacitance	c_{ob}	$V_{CB} = 10V, f = 1MHz$		80		pF
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C = 1mA, I_E = 0$		500		V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_C = 10mA, R_{BE} = \infty$		400		V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E = 1mA, I_C = 0$		7		V
C-E Sustain Voltage	$V_{CEO(sus)}$	$I_C = 8A, I_B = 1.6A, L = 50\mu H$		400		V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 8A, I_{B1} = 1.6A, L = 200\mu H,$		400		V
	(1)	$I_{B2} = -1.6A, \text{clamped}$				
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 1.5A, I_{B1} = 0.3A, L = 200\mu H$		450		V
	(2)	$I_{B2} = -0.3A, \text{clamped}$				

Case Outline 2022

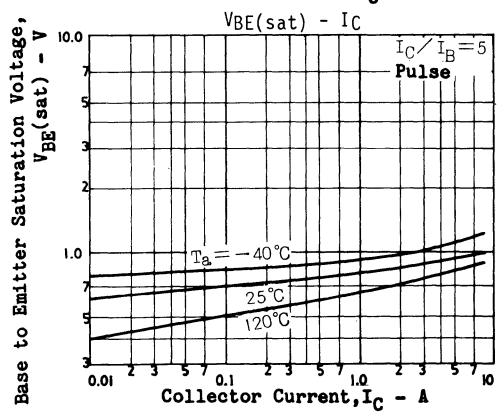
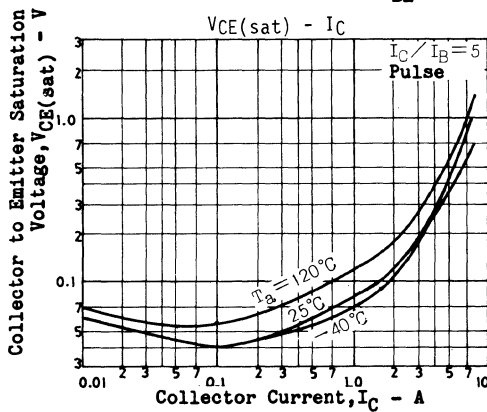
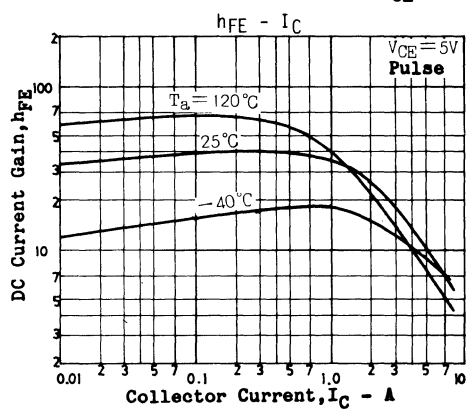
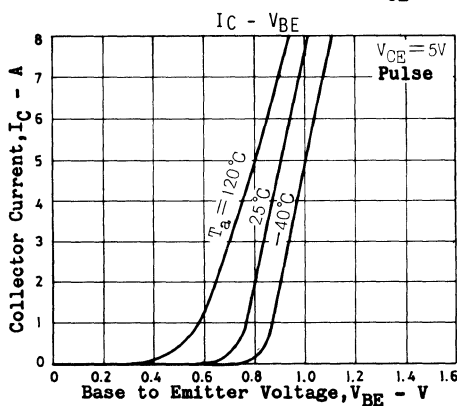
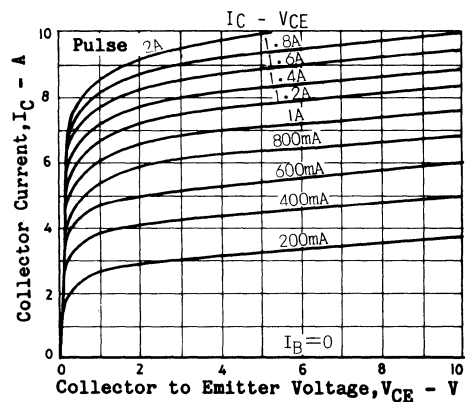
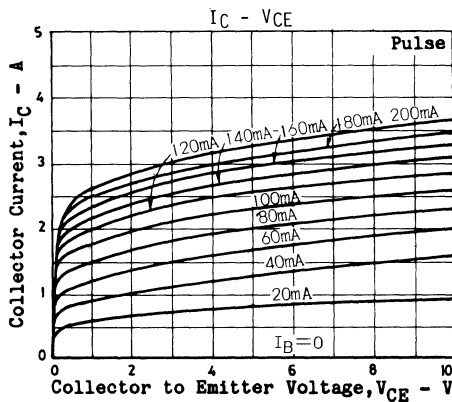
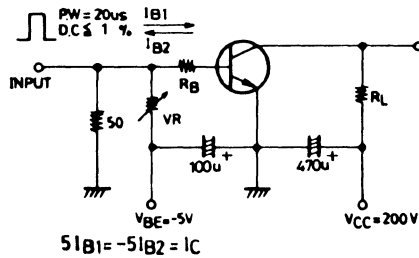
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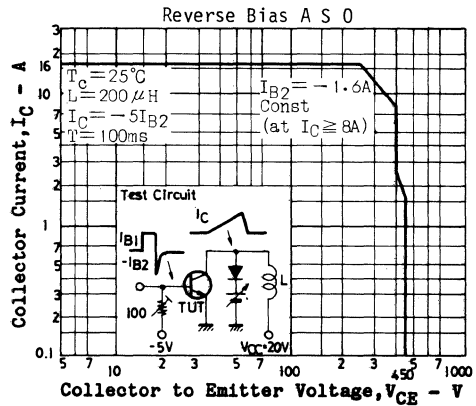
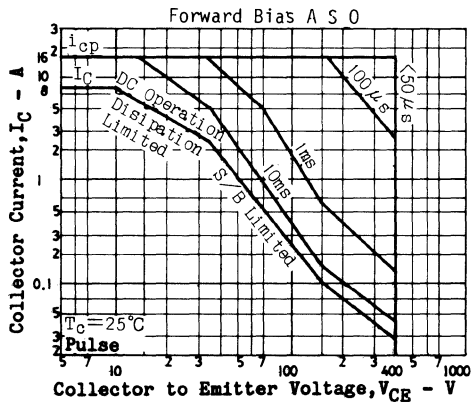
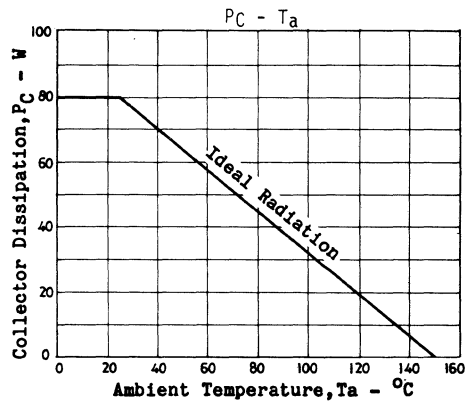
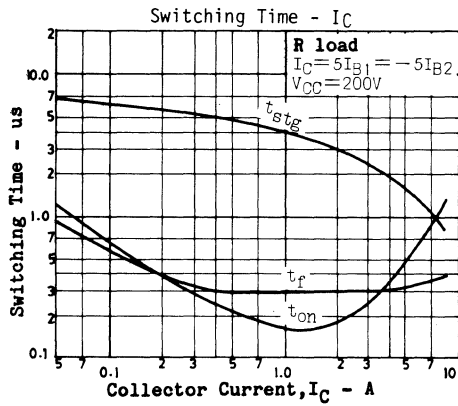


3095MY, TS No.997-1/3

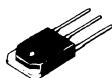
			min	typ	max	unit
Turn-ON Time	t_{on}	$I_C=5A, I_{B1}=1A, I_{B2}=-1A,$ $R_L=40\Omega, V_{CC}=200V$			1.0	us
Storage Time	t_{stg}	" "			2.5	us
Fall Time	t_f	" "			1.0	us

Switching Time Test Circuit





2SC3042



2022

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©938A

Features

- . High breakdown voltage($V_{CB0} \geq 500V$)
- . Fast switching speed.
- . Wide ASO.

Absolute Maximum Ratings at $T_a = 25^\circ C$

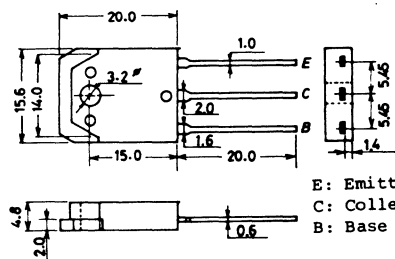
			unit
Collector to Base Voltage	V_{CB0}	500	V
Collector to Emitter Voltage	V_{CEO}	400	V
Emitter to Base Current	V_{EBO}	7	V
Collector Current	I_C	12	A
Peak Collector Current	i_{cp}	25	A
	$PW \leq 300\mu s$, Duty Cycle $\leq 10\%$		
Base Current	I_B	4	A
Collector Dissipation	P_C	2.5	W
	$T_c = 25^\circ C$	100	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = 400V, I_E = 0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 5V, I_C = 0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = 5V, I_C = 1.6A$		15		
	$h_{FE}(2)$	$V_{CE} = 5V, I_C = 8A$		8		
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = 8A, I_B = 1.6A$			1.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = 8A, I_B = 1.6A$			1.5	V
Gain Bandwidth Product	f_T	$V_{CE} = 10V, I_C = 1.6A$		20		MHz
Output Capacitance	c_{ob}	$V_{CB} = 10V, f = 1MHz$		160		pF
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C = 1mA, I_E = 0$		500		V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_C = 10mA, R_{BE} = \infty$		400		V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E = 1mA, I_C = 0$		7		V
C-E Sustain Voltage	$V_{CEO(sus)}$	$I_C = 12A, I_B = 2.4A, L = 50\mu H$		400		V
C-E Sustain Voltage	$V_{CEX(sus)}(1)$	$I_C = 12A, I_{B1} = 2.4A, L = 200\mu H$ $I_{B2} = -2.4A$, clamped		400		V
C-E Sustain Voltage	$V_{CEX(sus)}(2)$	$I_C = 3A, I_{B1} = 0.6A, L = 200\mu H$ $I_{B2} = -0.6A$, clamped		450		V

Case Outline 2022

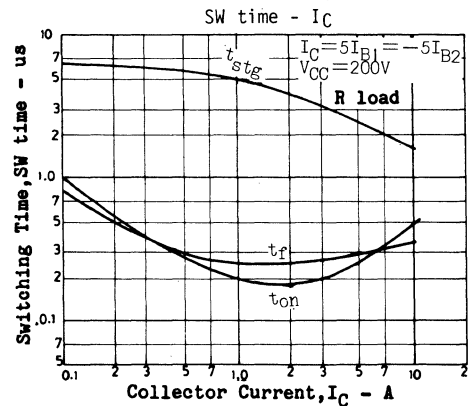
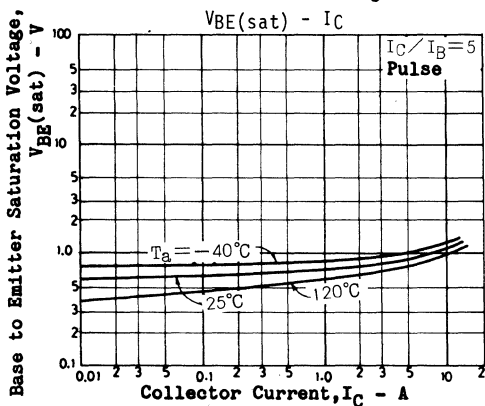
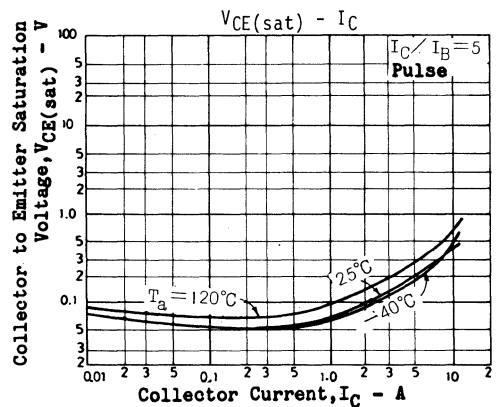
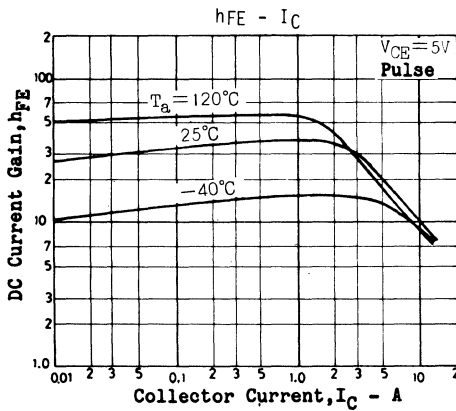
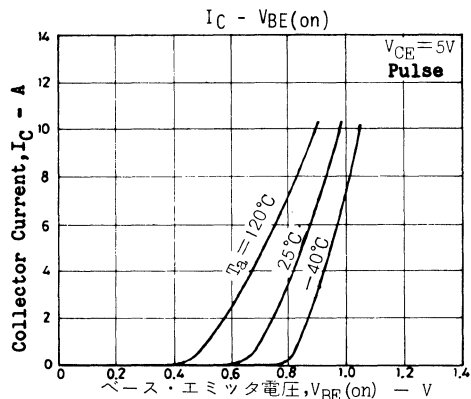
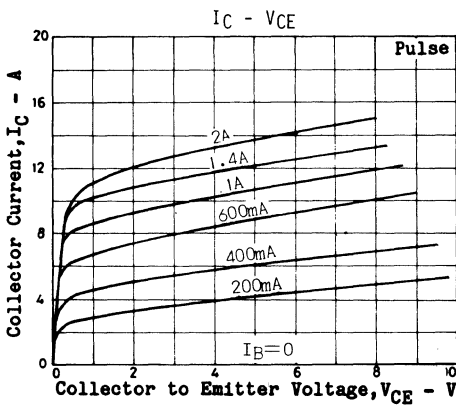
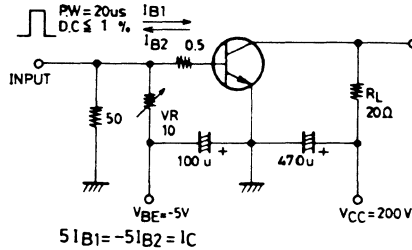
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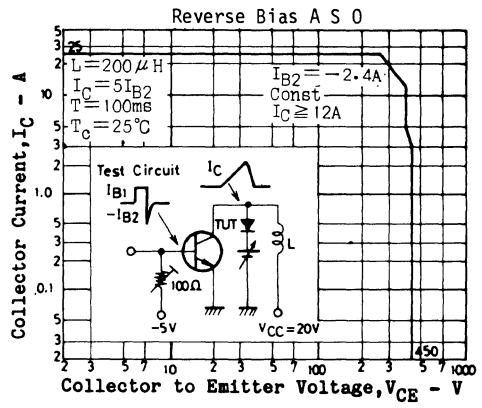
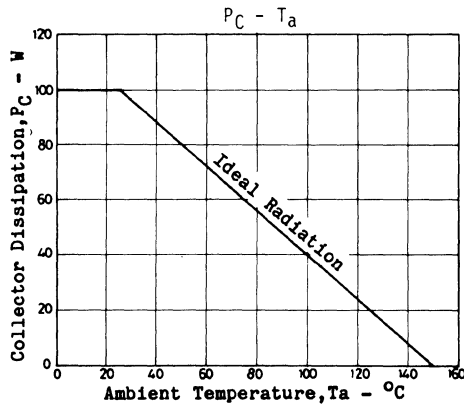
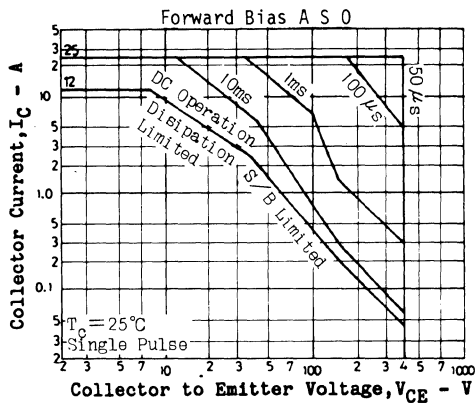


3095MY, TS No.938-1/3

			min	typ	max	unit
Turn-ON Time	t_{on}	$I_C=10A, I_{B1}=2A, I_{B2}=-2A,$ $R_L=20\Omega, V_{CC}=200V$			1.0	us
Storage Time	t_{stg}	" "			2.5	us
Fall Time	t_f	" "			1.0	us

Switching Time Test Circuit





2SC3064



2029A



2030A

NPN Epitaxial Planar
Silicon Composite Transistor

Differential Amp Applications

©958A

Applications

- . Differential amp, current mirror, temperature compensator.

Features

- . Excellent in thermal equilibrium and suited for use in differential amp applications.
- . Matched pair capability.

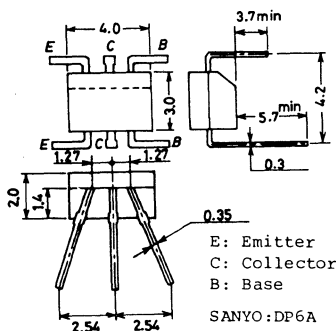
Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CBO}	55	V
Collector to Emitter Voltage	V_{CEO}	50	V
Emitter to Base Current	V_{EBO}	6	V
Collector Current	I_C	150	mA
Peak Collector Current	i_{cp}	300	mA
Collector Dissipation	P_C	200	mW
Total Dissipation	P_T	400	mW
Junction Temperature	T_J	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

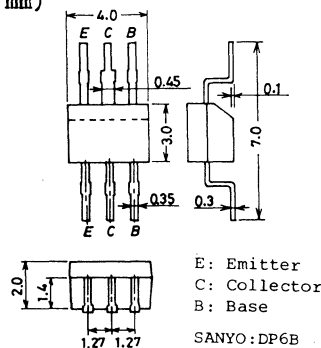
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=35V, I_E=0$			0.1	uA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4V, I_C=0$			0.1	uA
DC Current Gain	h_{FE}	$V_{CE}=6V, I_C=1mA$	100		960	
DC Current Gain Ratio	$h_{FE(small/large)}$	$V_{CE}=6V, I_C=1mA$	0.85	0.98		
Base to Emitter Voltage Drop	$V_{BE(large-small)}$	$V_{CE}=6V, I_C=1mA$		1.0	10	mV
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=50mA, I_B=5mA$			0.5	V
Gain Bandwidth Product	f_T	$V_{CE}=6V, I_C=1mA$		100		MHz
Output Capacitance	C_{ob}	$V_{CB}=10V, f=1MHz$		2.5		pF

Case Outline 2029A
(unit:mm)



Case Outline 2030A
(unit:mm)

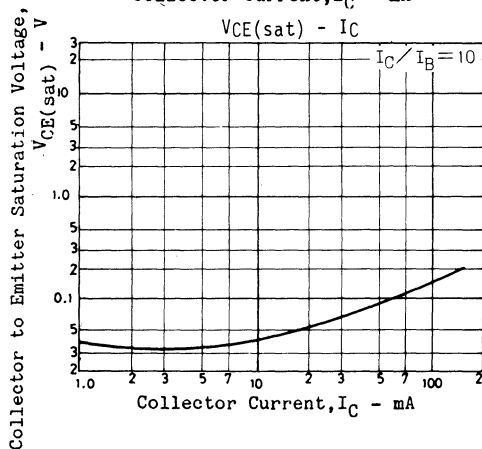
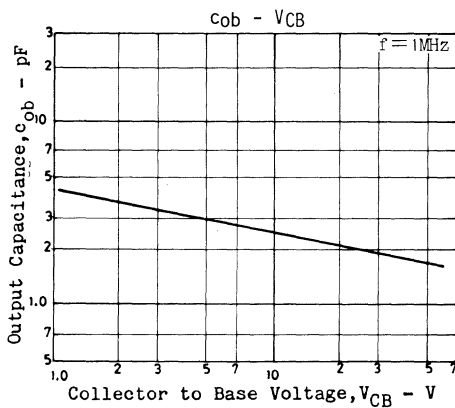
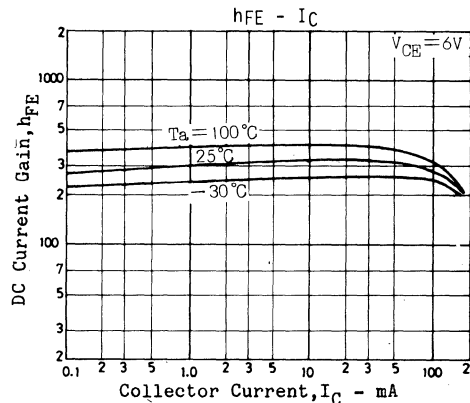
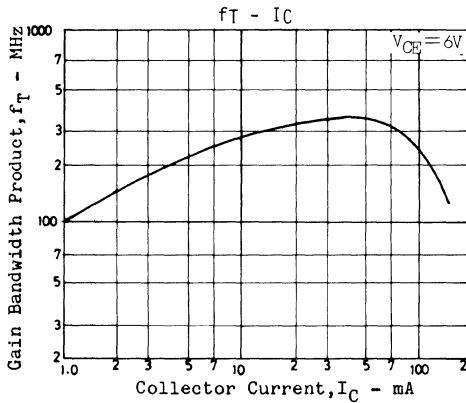
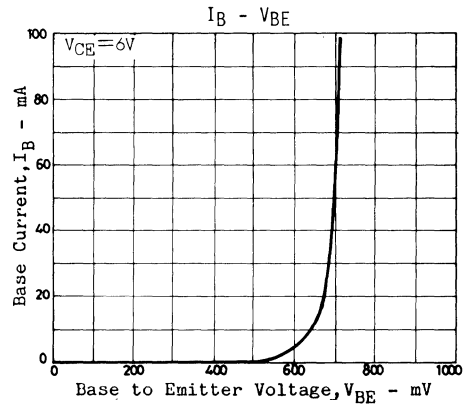
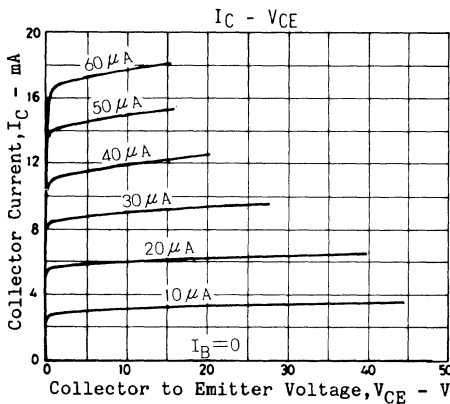


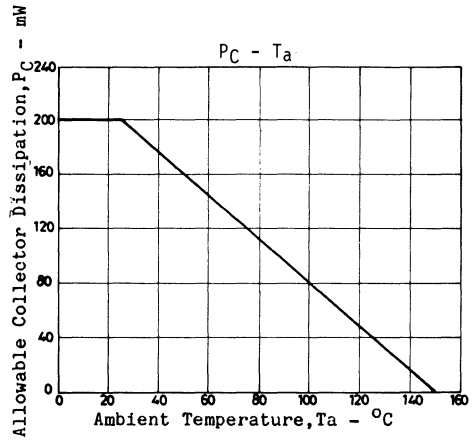
E: Emitter
C: Collector
B: Base
SANYO:DP6B

Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu A, I_E=0$	min 55	typ	max	unit V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, R_{BE}=\infty$	50			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu A, I_C=0$	5			V

*The 2SC3064 is classified by $h_{FE}(\text{small})$ as follows:

100	E	200	160	F	320	280	G	560	480	H	960
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2SC3065



2029A



2030A

NPN Epitaxial Planar
Silicon Composite Transistor

Differential Amp Applications

©974A

Applications

- . Differential amp, current mirror, temperature compensator.

Features

- . Excellent in thermal equilibrium and suited for use in differential amp applications.
- . Low noise.
- . Matched pair capability.

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	55	V
Collector to Emitter Voltage	V_{CE0}	50	V
Emitter to Base Current	V_{EBO}	6	V
Collector Current	I_C	150	mA
Peak Collector Current	i_{cp}	300	mA
Collector Dissipation	P_C	200	mW
Total Dissipation	P_T	400	mW
Junction Temperature	T_J	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

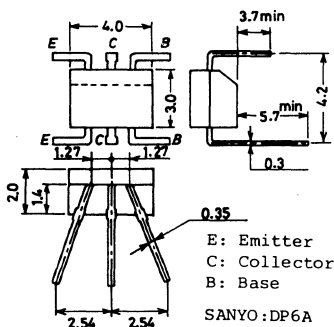
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=35\text{V}, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4\text{V}, I_C=0$			0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=6\text{V}, I_C=1\text{mA}$	100		960	
DC Current Gain Ratio	$h_{FE(\text{small/large})}$	$V_{CE}=6\text{V}, I_C=1\text{mA}$	0.85	0.98		
Base to Emitter Voltage Drop	$V_{BE(\text{large-small})}$	$V_{CE}=6\text{V}, I_C=1\text{mA}$		1.0	10	mV
Collector to Emitter Saturation Voltage	$V_{CE(\text{sat})}$	$I_C=50\text{mA}, I_B=5\text{mA}$			0.5	V
Gain Bandwidth Product	f_T	$V_{CE}=6\text{V}, I_C=1\text{mA}$		100		MHz
Output Capacitance	c_{ob}	$V_{CB}=10\text{V}, f=1\text{MHz}$		2.5		pF
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu\text{A}, I_E=0$	55			V

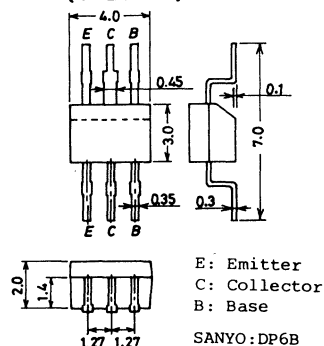
*The 2SC3065 is classified by $h_{FE(\text{small})}$ as follows:

100	E	200
160	F	320
280	G	560
480	H	960

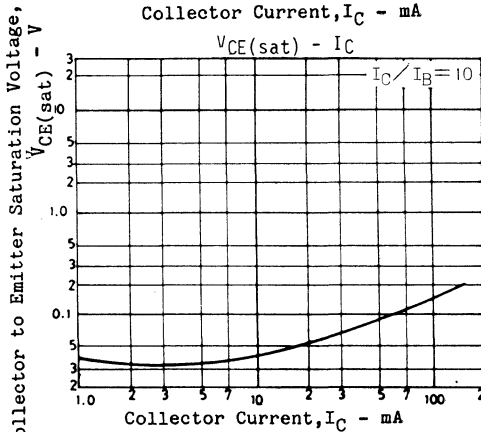
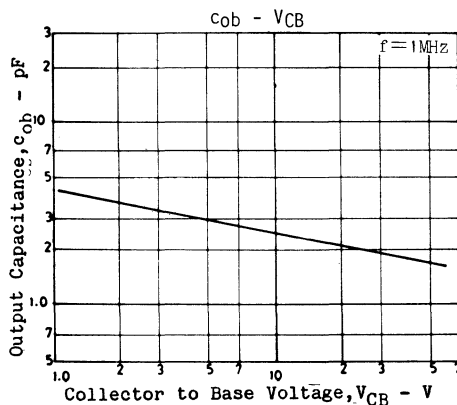
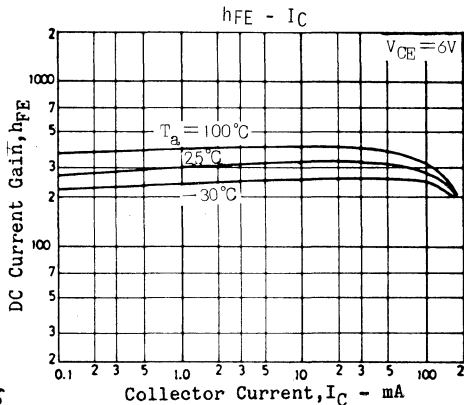
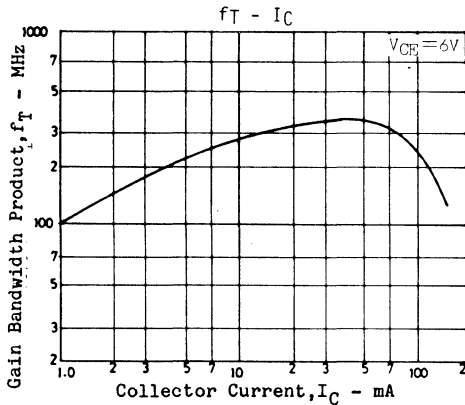
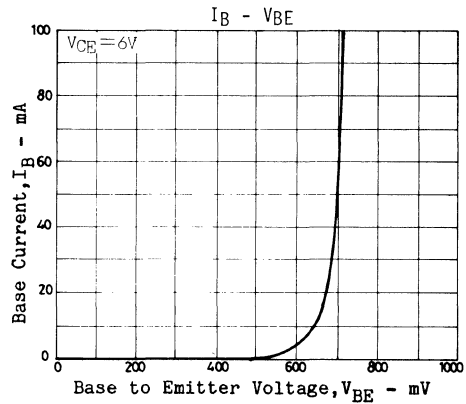
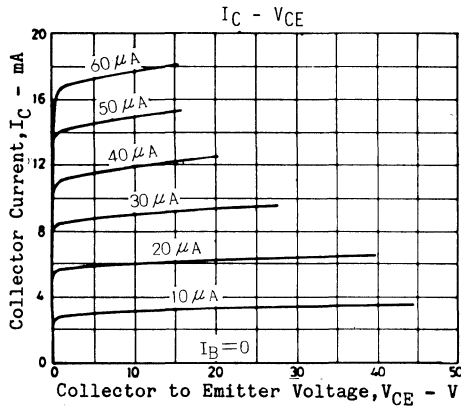
Case Outline 2029A
(unit:mm)

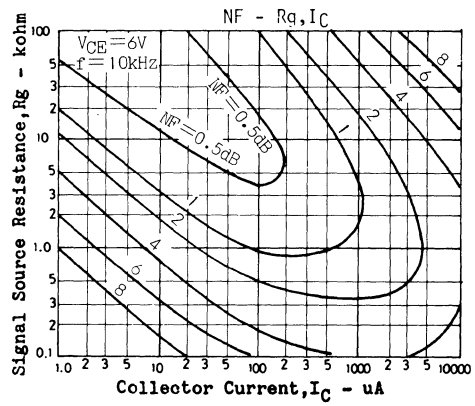
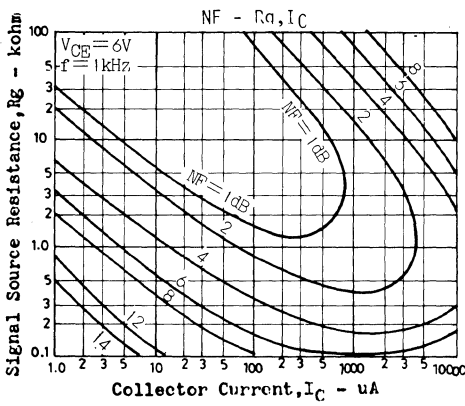
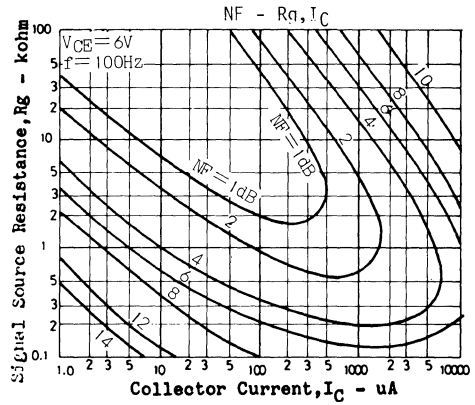
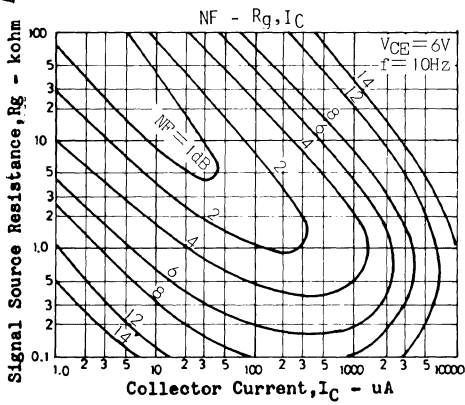
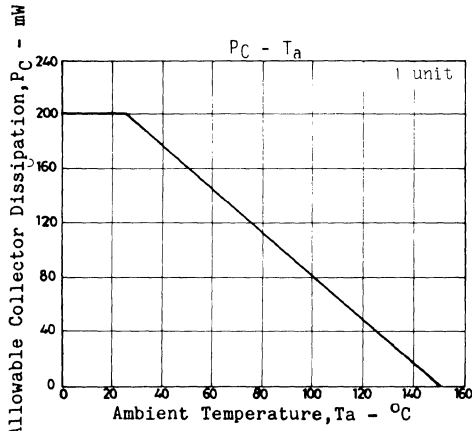


Case Outline 2030A
(unit:mm)



Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu A, I_E=0$	55	V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, R_{BE}=\infty$	50	V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu A, I_C=0$	5	V
Noise Level	$V_{NO(ave)}$	$V_{CC}=30V, I_C=1mA, R_g=56k\Omega, V_G=77dB/1kHz$	35	mV
Noise Peak Level	$V_{NO(peak)}$	$V_{CC}=30V, I_C=1mA, R_g=56k\Omega, V_G=77dB/1kHz$	200	mV





2SC3066



2029A



2030A

NPN Epitaxial Planar
Silicon Composite Transistor

Differential Amp Applications

©976A

Applications

- . Differential amp, current mirror

Features

- . Excellent in thermal equilibrium and suited for use in differential amp applications.
- . Matched pair capability.

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	130	V
Collector to Emitter Voltage	V_{CEO}	120	V
Emitter to Base Current	V_{EBO}	5	V
Collector Current	I_{C}	50	mA
Peak Collector Current	i_{cp}	100	mA
Collector Dissipation	P_{C}	200	mW
Total Dissipation	P_{T}	400	mW
Junction Temperature	T_{J}	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

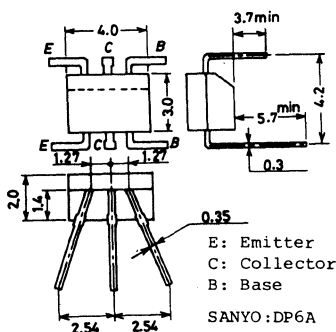
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{\text{CB}}=80\text{V}, I_{\text{E}}=0$			0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{\text{EB}}=4\text{V}, I_{\text{C}}=0$			0.1	μA
DC Current Gain	h_{FE}	$V_{\text{CE}}=6\text{V}, I_{\text{C}}=1\text{mA}$	160		960	
DC Current Gain Ratio	$h_{\text{FE}}(\text{small/large})$	$V_{\text{CE}}=6\text{V}, I_{\text{C}}=1\text{mA}$	0.85	0.98		
Base to Emitter Voltage Drop	$V_{\text{BE}}(\text{large-small})$	$V_{\text{CE}}=6\text{V}, I_{\text{C}}=1\text{mA}$		1.0	10	mV
Collector to Emitter Saturation Voltage	$V_{\text{CE}}(\text{sat})$	$I_{\text{C}}=10\text{mA}, I_{\text{B}}=1\text{mA}$			0.5	V
Gain Bandwidth Product	f_{T}	$V_{\text{CE}}=6\text{V}, I_{\text{C}}=1\text{mA}$		130		MHz
Output Capacitance	c_{ob}	$V_{\text{CB}}=10\text{V}, f=1\text{MHz}$		1.6		pF

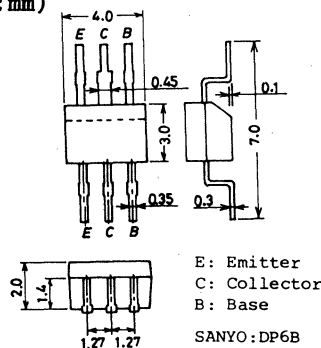
* The 2SC3066 is classified by $h_{\text{FE}}(\text{small})$ as follows:

160	F	320	280	G	560	480	H	960
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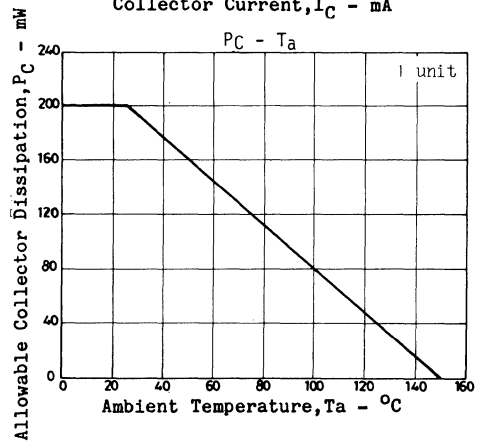
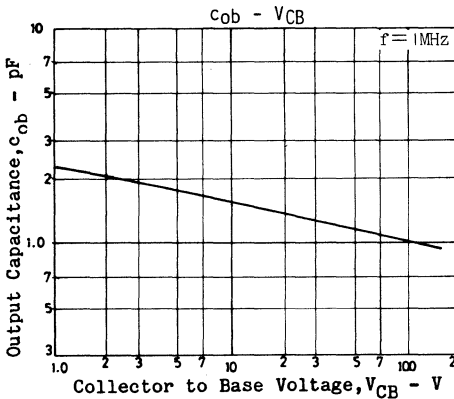
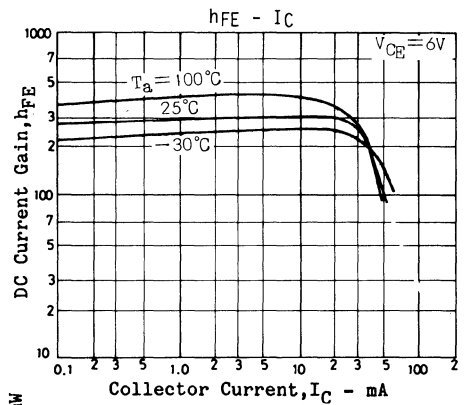
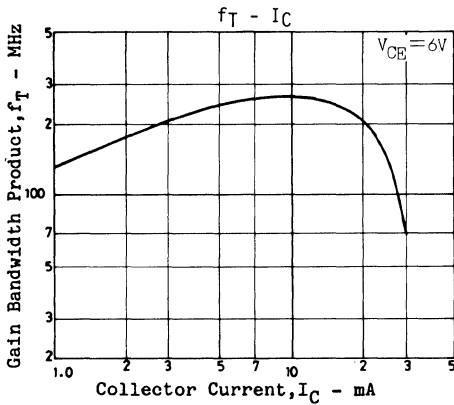
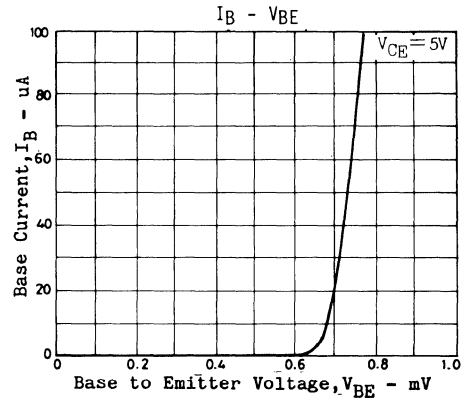
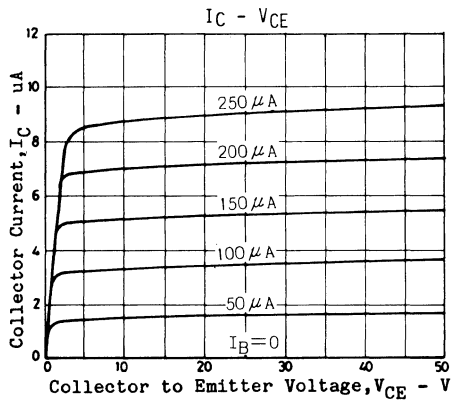
Case Outline 2029A
(unit:mm)



Case Outline 2030A
(unit:mm)



Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu A, I_E=0$	min 130	typ	max	unit
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, R_{BE}=\infty$	120			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu A, I_C=0$	5			V



2SC3067



2029A



2030A

NPN Epitaxial Planar
Silicon Composite Transistor

Differential Amp Applications

Ⓔ978A

Applications

- . Differential amp, current mirror

Features

- . Excellent in thermal equilibrium and suited for use in differential amp applications.
- . Low noise.
- . Matched pair capability.

Absolute Maximum Ratings at Ta=25°C

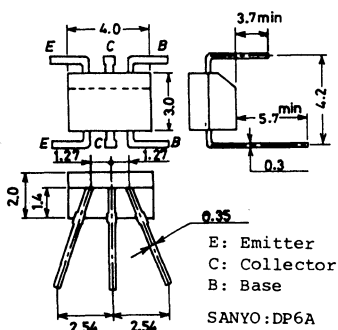
			unit
Collector to Base Voltage	V_{CB0}	130	V
Collector to Emitter Voltage	V_{CEO}	120	V
Emitter to Base Current	V_{EBO}	5	V
Collector Current	I_C	50	mA
Peak Collector Current	i_{cp}	100	mA
Collector Dissipation	P_C	200	mW
Total Dissipation	P_T	400	mW
Junction Temperature	T_J	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

1 unit

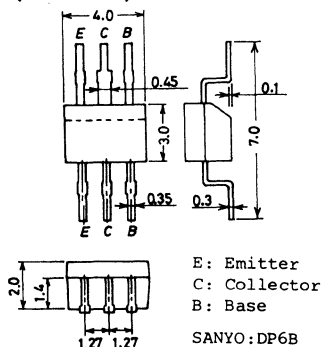
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=80V, I_E=0$			0.1	uA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4V, I_C=0$			0.1	uA
DC Current Gain	h_{FE}	$V_{CE}=6V, I_C=1mA$	160		960	
DC Current Gain Ratio	$h_{FE(small/large)}$	$V_{CE}=6V, I_C=1mA$	0.85	0.98		
Base to Emitter Voltage Drop	$V_{BE(large-small)}$	$V_{CE}=6V, I_C=1mA$		1.0	10	mV
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=10mA, I_B=1mA$			0.5	V
Gain Bandwidth Product	f_T	$V_{CE}=6V, I_C=1mA$		130		MHz
Output Capacitance	c_{ob}	$V_{CB}=10V, f=1MHz$		1.6		pF

Case Outline 2029A
(unit:mm)



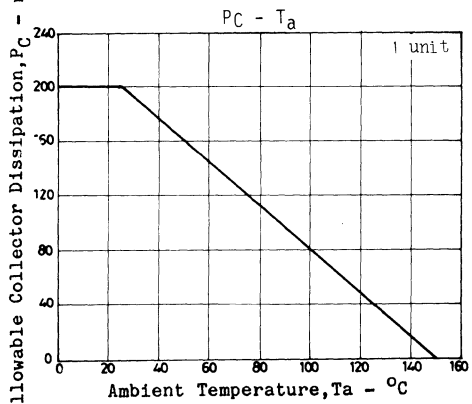
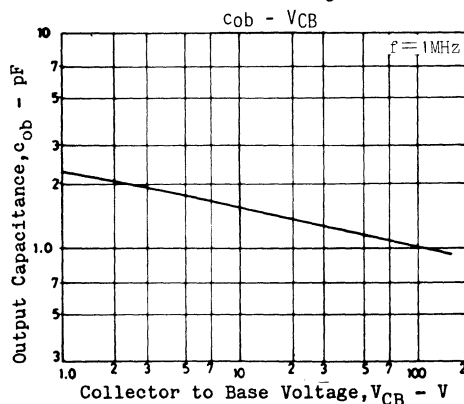
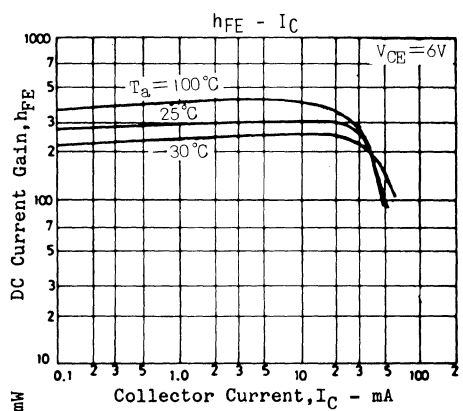
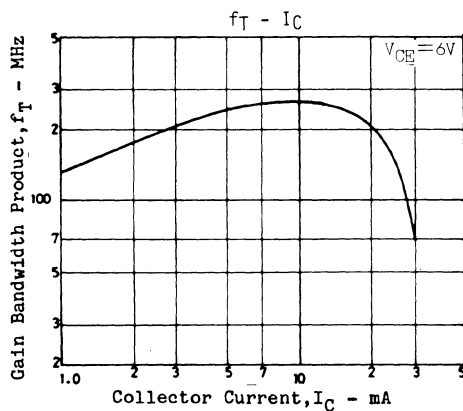
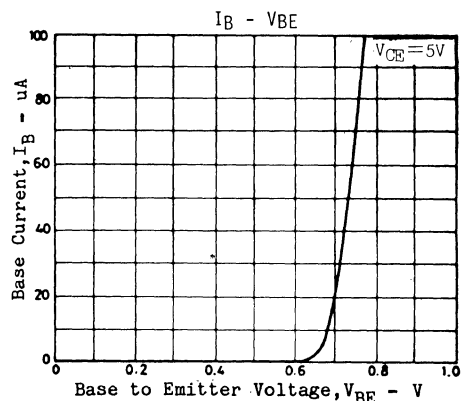
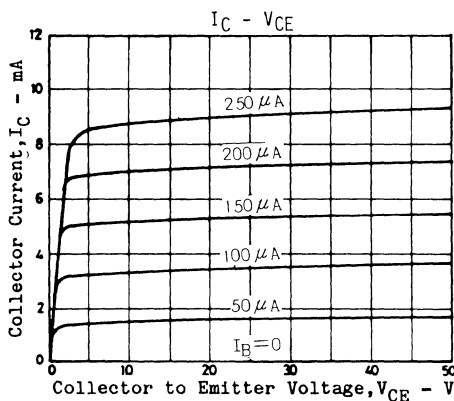
Case Outline 2030A
(unit:mm)

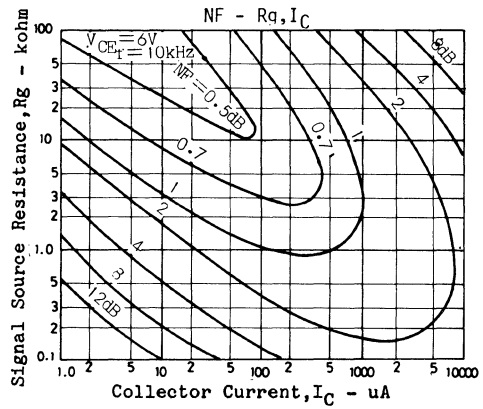
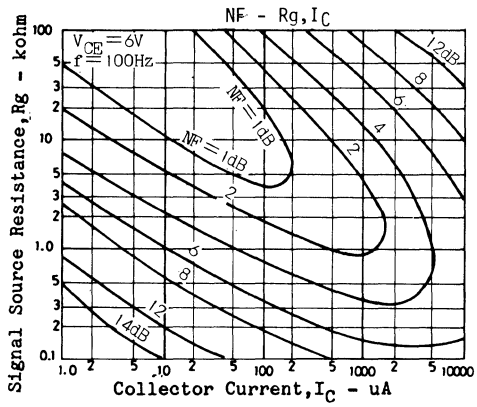
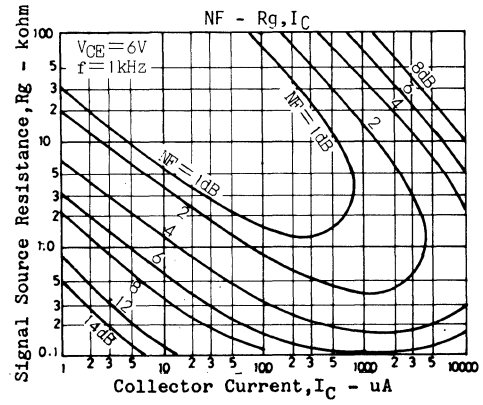
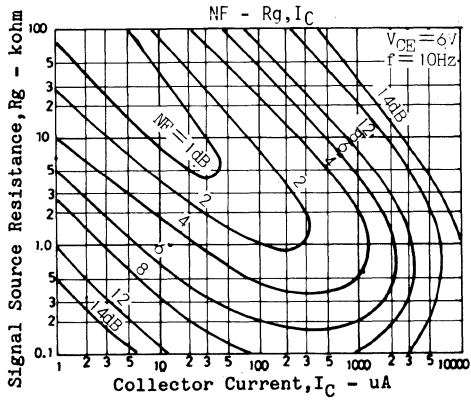


			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu A, I_E=0$	130			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, R_{BE}=\infty$	120			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu A, I_C=0$	5			V
Noise Level	$V_{NO(ave)}$	$V_{CC}=30V, I_C=1mA, R_g=56k\Omega, V_G=77dB/1kHz$			35	mV
Noise Peak Level	$V_{NO(peak)}$	$V_{CC}=30V, I_C=1mA, R_g=56k\Omega, V_G=77dB/1kHz$			200	mV

*The 2SC3067 is classified by $h_{FE}(small)$ as follows:

160	F	320	280	G	560	480	H	960
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2SC3068



2003A

NPN Epitaxial Planar
Silicon Transistor

High h_{FE} , Low Frequency, General-Purpose Amp Applications

©943D

Applications

- Low-frequency, general-purpose amp., various drivers, muting circuit

Features

- High DC current gain ($h_{FE}=800$ to 3200)
- Large current capacity
- Low collector-to-emitter saturation voltage ($V_{CE(sat)}=0.5V$ max.)
- High V_{EBO} ($V_{EBO}\geq 15V$)

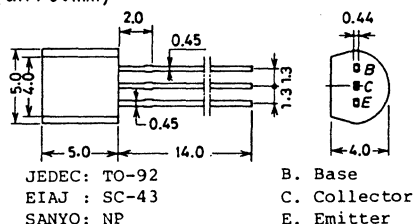
Absolute Maximum Ratings/ $T_a=25^\circ C$

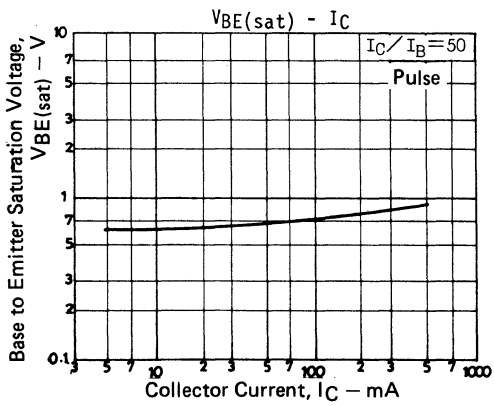
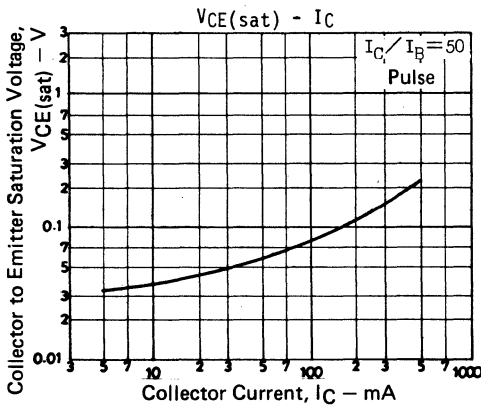
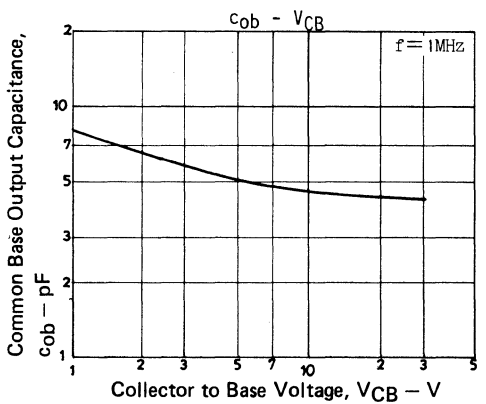
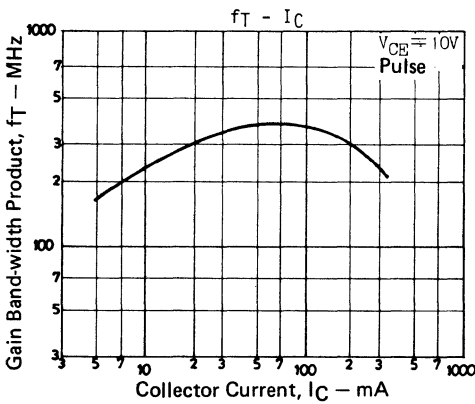
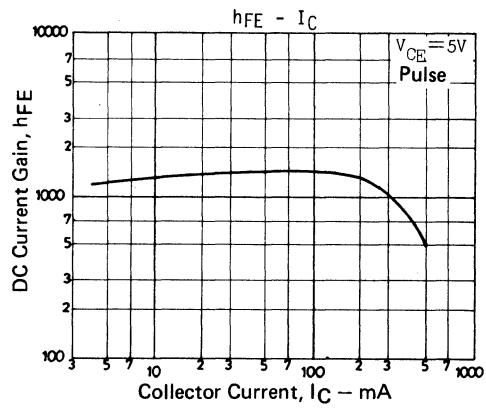
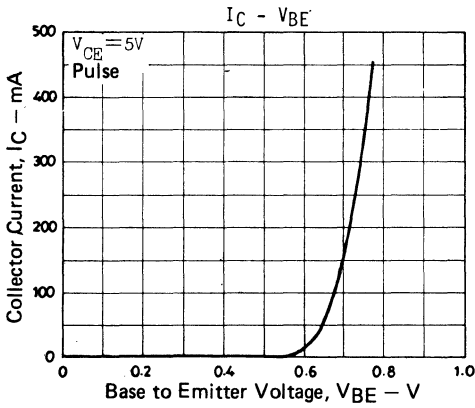
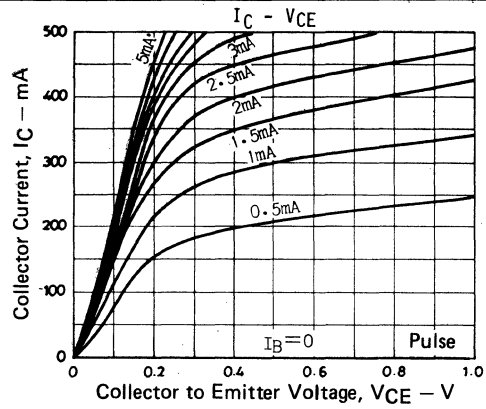
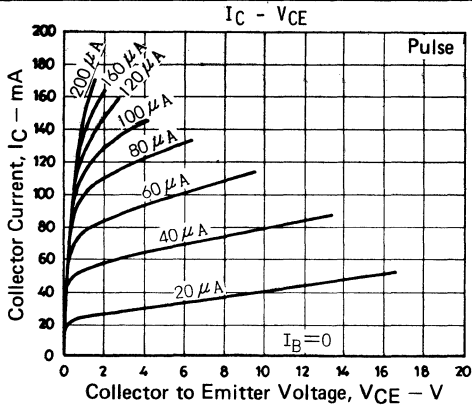
			unit
Collector to Base Voltage	V_{CBO}	30	V
Collector to Emitter Voltage	V_{CEO}	25	V
Emitter to Base Voltage	V_{EBO}	15	V
Collector Current	I_C	300	mA
Peak Collector Current	i_{cp}	500	mA
Collector Dissipation	P_C	600	mW
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

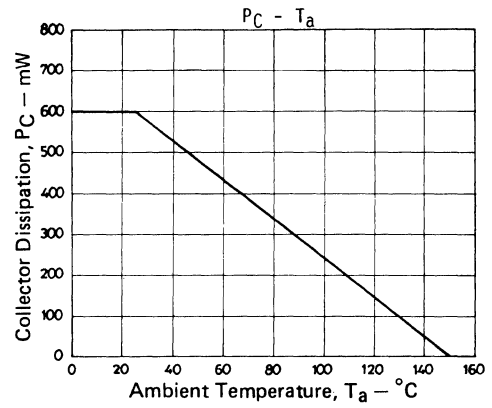
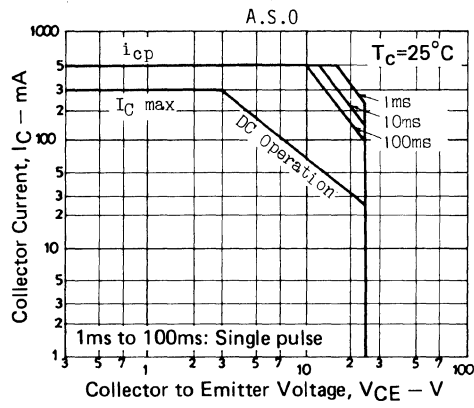
Electrical Characteristics/ $T_a=25^\circ C$

			min	typ	max	unit
Collector Cut-off Current	I_{CBO}	$V_{CB}=20V, I_E=0$			0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=10V, I_C=0$			0.1	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5V, I_C=10mA$	800	1500	3200	
	$h_{FE}(2)$	$V_{CE}=5V, I_C=200mA$	600			
Gain Band-width Product	f_T	$V_{CE}=10V, I_C=10mA$		250		MHz
Common Base Output Capacitance	c_{ob}	$V_{CB}=10V, f=1MHz$		4.5		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=200mA, I_B=4mA$		0.12	0.5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=200mA, I_B=4mA$		0.85	1.2	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu A, I_E=0$	30			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, I_B=0$	25			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu A, I_C=0$	15			V

Case Outline 2003A (unit:mm)







2SC3069



2003A

NPN Epitaxial Planar
Silicon Transistor

High h_{FE} , Low Frequency, General-Purpose Amp Applications

©934D

Applications

- Low-frequency, general-purpose amp., various drivers, muting circuit

Features

- High DC current gain ($h_{FE}=800$ to 3200)
- Low collector-to-emitter saturation voltage: $V_{CE(sat)}=0.5V$ max.
- High $VEBO$ ($VEBO \geq 15V$)

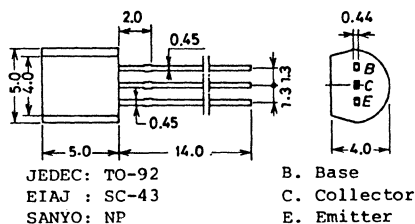
Absolute Maximum Ratings/ $T_a=25^\circ C$

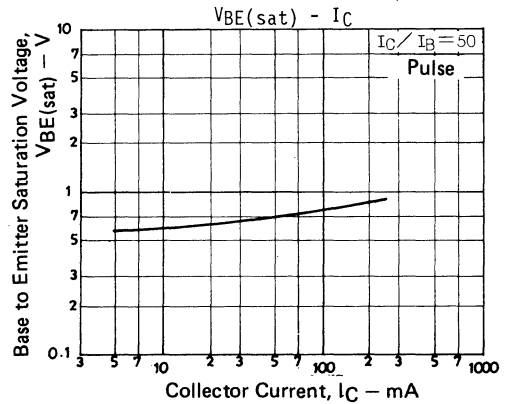
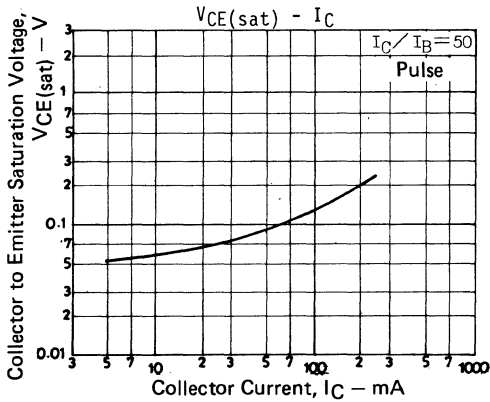
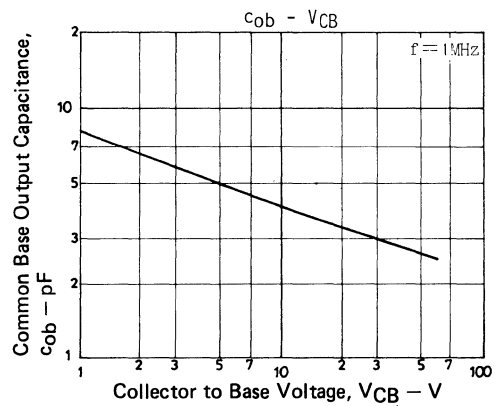
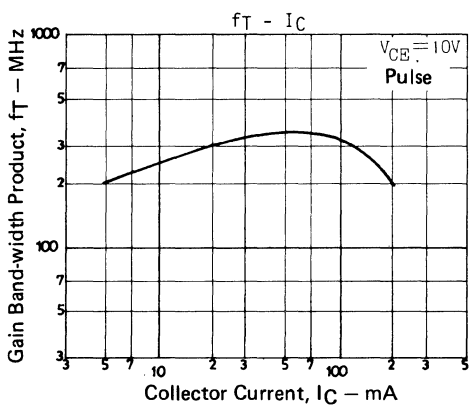
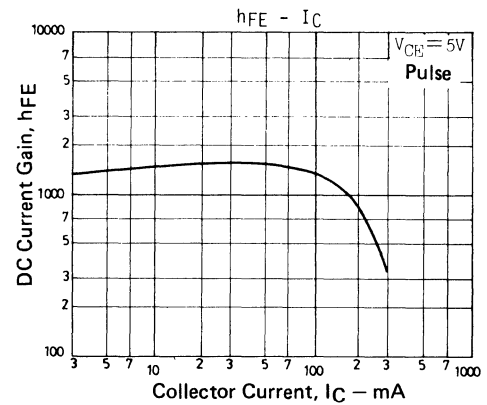
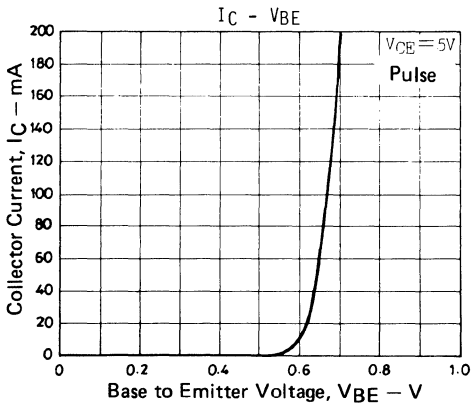
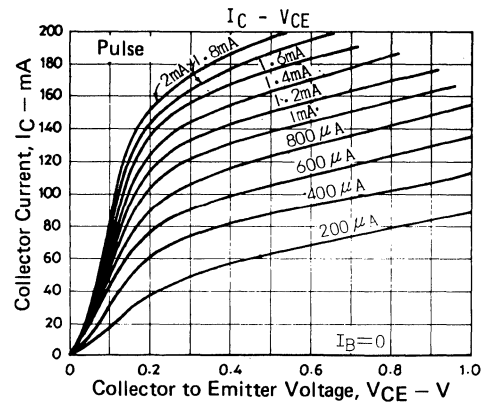
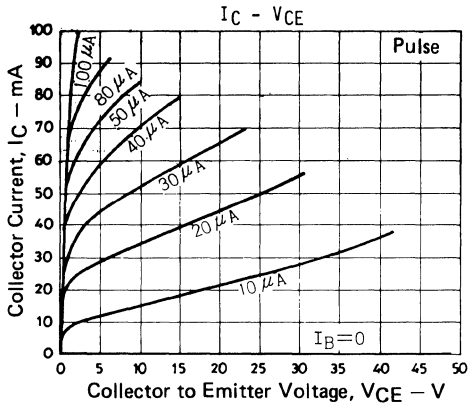
			unit
Collector to Base Voltage	V_{CBO}	60	V
Collector to Emitter Voltage	V_{CEO}	50	V
Emitter to Base Voltage	$VEBO$	15	V
Collector Current	I_C	200	mA
Peak Collector Current	i_{cp}	300	mA
Collector Dissipation	P_C	600	mW
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

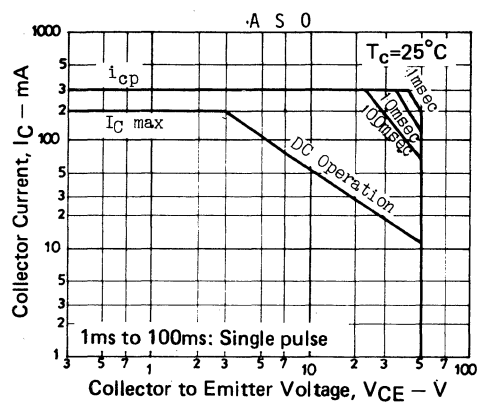
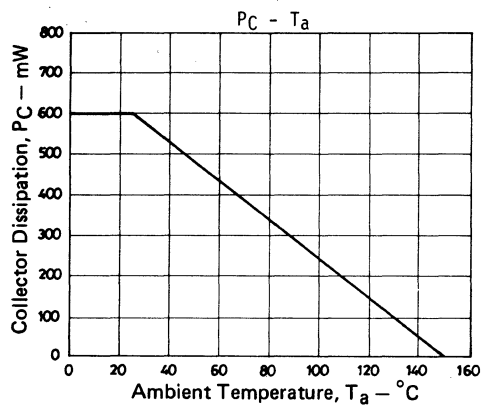
Electrical Characteristics/ $T_a=25^\circ C$

			min	typ	max	unit
Collector Cut-off Current	I_{CBO}	$V_{CB}=40V, I_E=0$			0.1	μA
Emitter Cut-off Current	I_{EBO}	$VEB=10V, I_C=0$			0.1	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5V, I_C=10mA$	800	1500	3200	
	$h_{FE}(2)$	$V_{CE}=5V, I_C=100mA$	600			
Gain Band-width Product	f_T	$V_{CE}=10V, I_C=10mA$		250		MHz
Common Base Output Capacitance	c_{ob}	$V_{CB}=10V, f=1MHz$		4.0		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=100mA, I_B=2mA$		0.12	0.5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=100mA, I_B=2mA$		0.85	1.2	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu A, I_E=0$	60			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, I_B=0$	50			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu A, I_C=0$	15			V

Case Outline 2003A (unit:mm)







2SC3070



2006A

NPN Epitaxial Planar
Silicon Transistor

High h_{FE} , Low Frequency, General-Purpose Amp Applications

©923D

Applications

- Low-frequency, general-purpose amp., various drivers, muting circuit

Features

- High DC current gain ($h_{FE}=800$ to 3200)
- Large Current capacity ($I_C=1.2A$)
- Low collector-to-emitter saturation voltage ($V_{CE(sat)}=0.5V$ max.)
- High V_{EBO} ($V_{EBO} \geq 15V$)

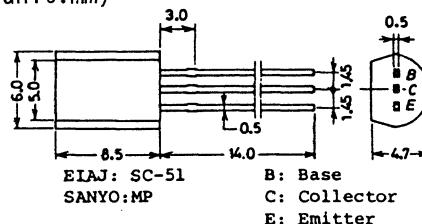
Absolute Maximum Ratings/ $T_a=25^\circ C$

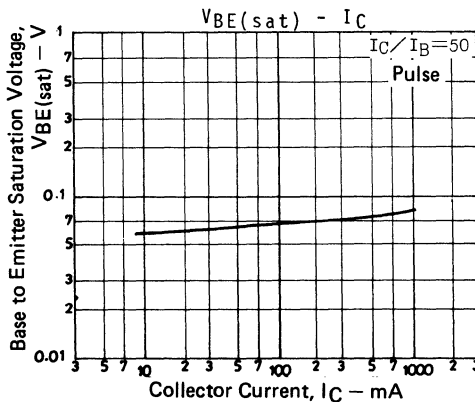
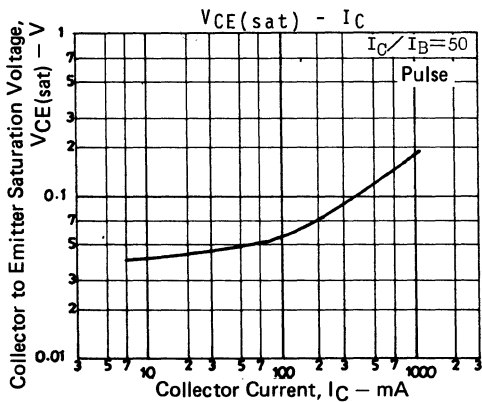
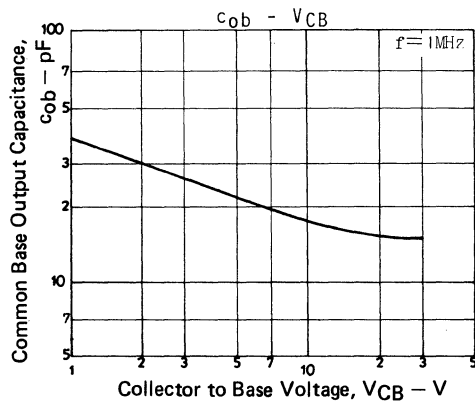
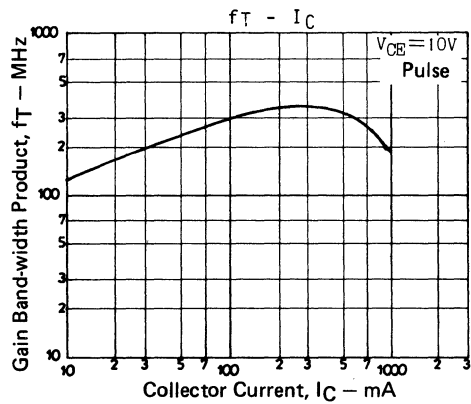
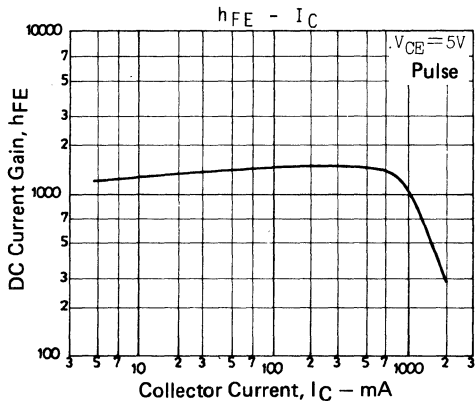
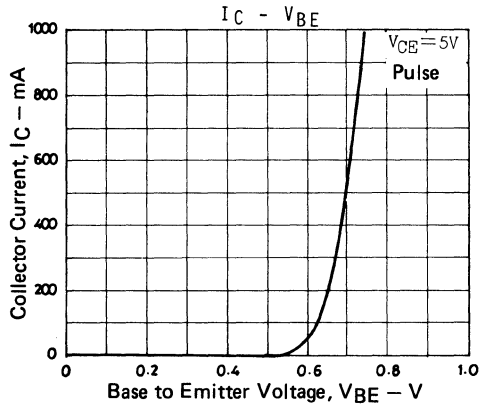
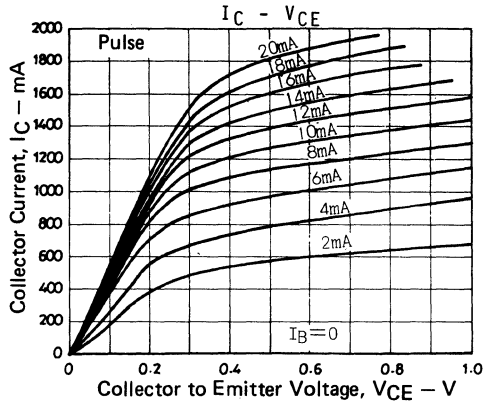
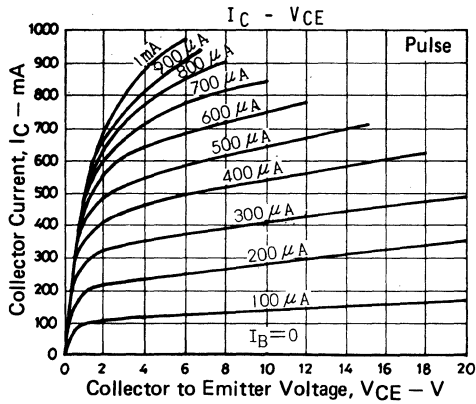
			unit
Collector to Base Voltage	V_{CBO}	30	V
Collector to Emitter Voltage	V_{CEO}	25	V
Emitter to Base Voltage	V_{EBO}	15	V
Collector Current	I_C	1.2	A
Peak Collector Current	i_{cp}	2	A
Collector Dissipation	P_C	1	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

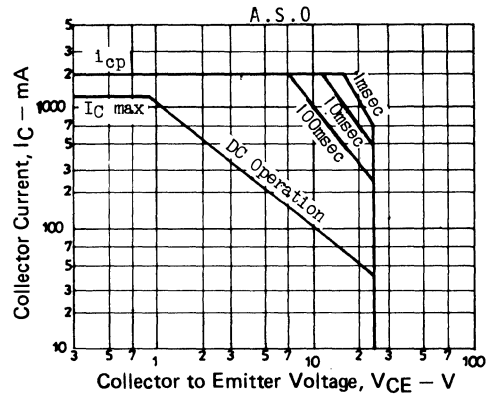
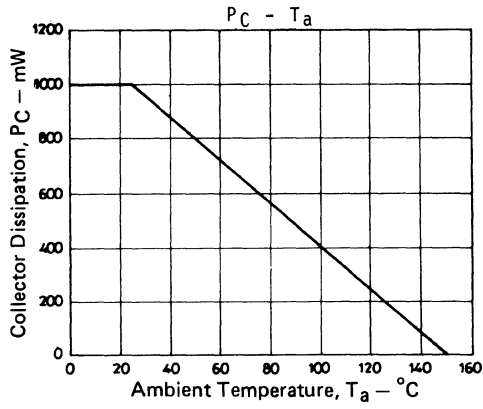
Electrical Characteristics/ $T_a=25^\circ C$

			min	typ	max	unit
Collector Cut-off Current	I_{CBO}	$V_{CB}=20V, I_E=0$			0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=10V, I_C=0$			0.1	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5V, I_C=500mA$	800	1500	3200	
	$h_{FE}(2)$	$V_{CE}=5V, I_C=10mA$	600			
Gain Band-width Product	f_T	$V_{CE}=10V, I_C=50mA$		220		MHz
Common Base Output Capacitance	c_{ob}	$V_{CB}=10V, f=1MHz$		17		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=500mA, I_B=10mA$		0.12	0.5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=500mA, I_B=10mA$		0.85	1.2	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu A, I_E=0$	30			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, I_B=0$	25			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu A, I_C=0$	15			V

Case Outline 2006A (unit:mm)







2SC3071



2006A

NPN Epitaxial Planar
Silicon Transistor

High h_{FE} , Low Frequency, General-Purpose Amp Applications

©946C

Applications

- Low-frequency, general-purpose amp., various drivers, muting circuit

Features

- High DC current gain ($h_{FE}=800$ to 2000)
- High voltage ($V_{CE0} \geq 100V$)
- Low collector-to-emitter saturation voltage ($V_{CE(sat)} \leq 0.5V$).
- High voltage ($V_{EBO} \geq 15V$)

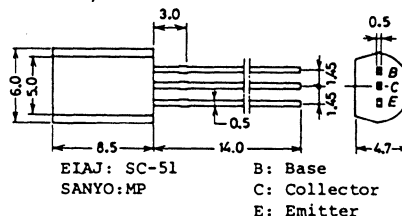
Absolute Maximum Ratings/ $T_a=25^\circ C$

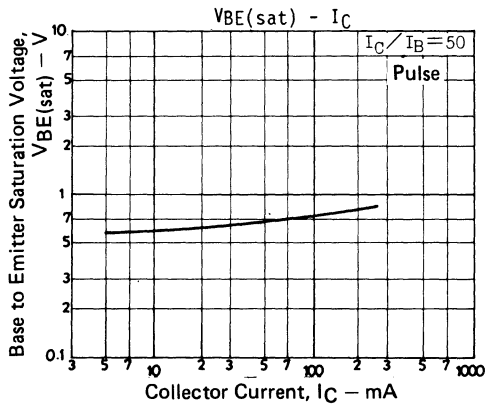
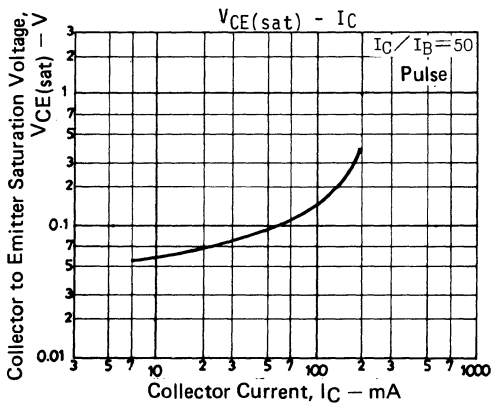
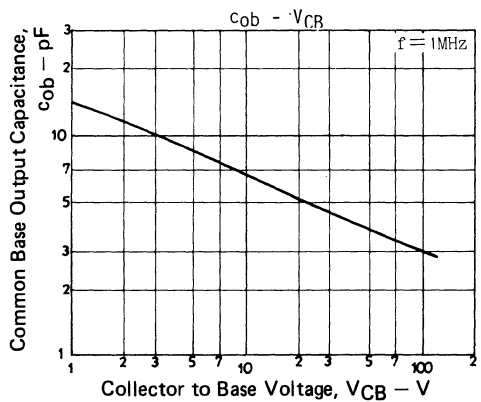
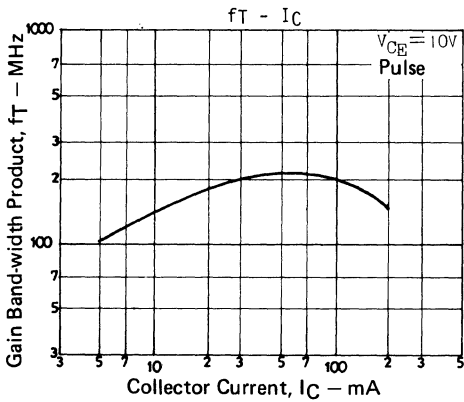
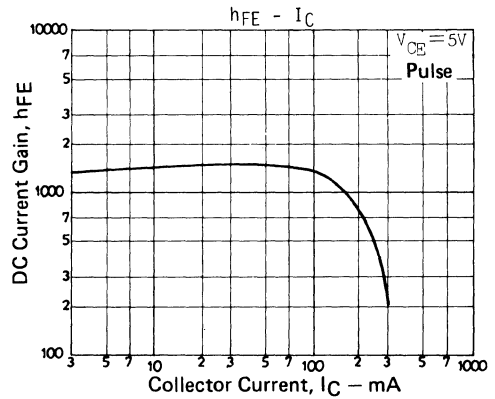
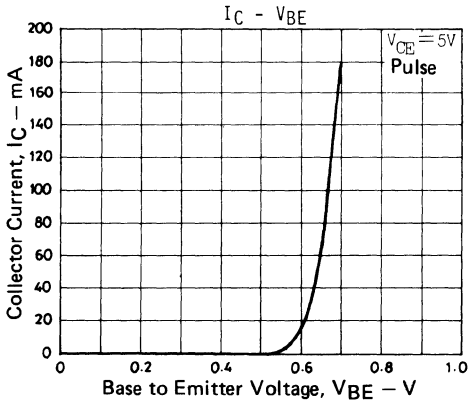
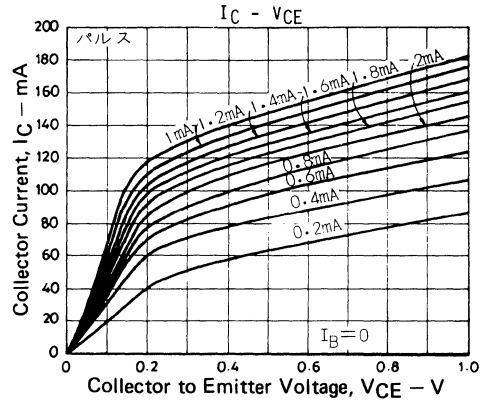
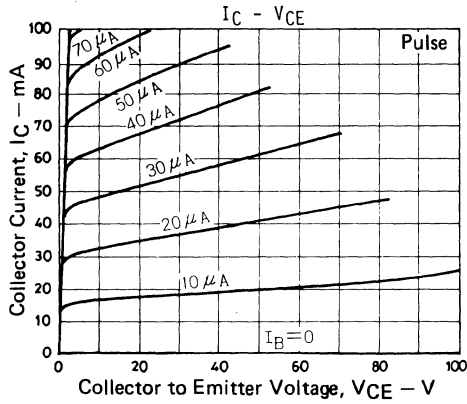
			unit
Collector to Base Voltage	V_{CBO}	120	V
Collector to Emitter Voltage	V_{CEO}	100	V
Emitter to Base Voltage	V_{EBO}	15	V
Collector Current	I_C	200	mA
Peak Collector Current	i_{cp}	300	mA
Collector Dissipation	P_C	1	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

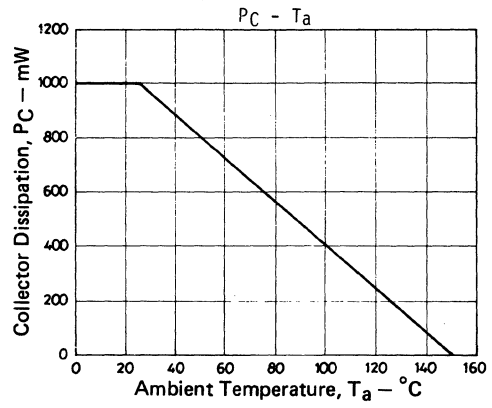
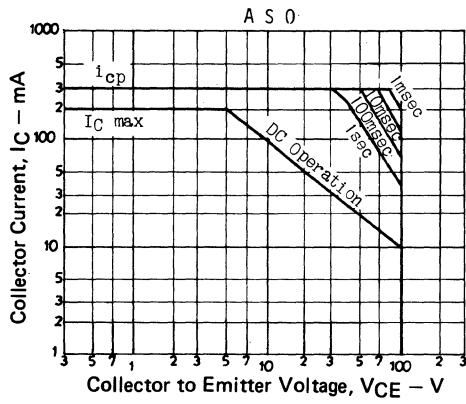
Electrical Characteristics/ $T_a=25^\circ C$

			min	typ	max	unit
Collector Cut-off Current	I_{CBO}	$V_{CB}=80V, I_E=0$			0.1	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=10V, I_C=0$			0.1	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5V, I_C=10mA$	500		2000	
	$h_{FE}(2)$	$V_{CE}=5V, I_C=100mA$	400			
Gain Band-width Product	f_T	$V_{CE}=10V, I_C=10mA$		150		MHz
Common Base Output Capacitance	c_{ob}	$V_{CB}=10V, f=1MHz$		6.5		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=100mA, I_B=2mA$		0.15	0.5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=100mA, I_B=2mA$		0.85	1.2	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu A, I_E=0$	120			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, I_B=0$	100			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu A, I_C=0$	15			V

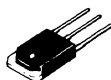
Case Outline 2006A (unit:mm)







2SC3083



2022

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©947A

Features

- High breakdown voltage($V_{CB0} \geq 500V$)
- Fast switching speed.
- Wide ASO.

Absolute Maximum Ratings at $T_a = 25^\circ C$

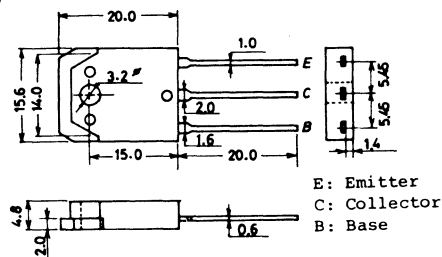
			unit
Collector to Base Voltage	V_{CB0}	500	V
Collector to Emitter Voltage	V_{CEO}	400	V
Emitter to Base Current	V_{EBO}	7	V
Collector Current	I_C	6	A
Peak Collector Current	i_{cp}	$PW \leq 300\mu s,$ Duty Cycle $\leq 10\%$	12 A
Base Current	I_B	2	A
Collector Dissipation	P_C	2.5	W
		$T_c = 25^\circ C$	60 W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = 400V, I_E = 0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 5V, I_C = 0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = 5V, I_C = 0.4A$	15			
	$h_{FE}(2)$	$V_{CE} = 5V, I_C = 2A$	8			
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = 2A, I_B = 0.4A$			1.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = 2A, I_B = 0.4A$			1.5	V
Gain Bandwidth Product	f_T	$V_{CE} = 10V, I_C = 0.4A$		20		MHz
Output Capacitance	c_{ob}	$V_{CB} = 10V, f = 1MHz$		40		pF
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 1mA, I_E = 0$		500		V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 5mA, R_{BE} = \infty$		400		V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 1mA, I_C = 0$		7		V
C-E Sustain Voltage	$V_{CEO(sus)}$	$I_C = 6A, I_B = 1.2A, L = 50\mu H$		400		V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 6A, I_{B1} = 1.2A, L = 200\mu H,$ $I_{B2} = -1.2A, \text{clamped}$		400		V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 0.75A, I_{B1} = 0.15A, L =$ $200\mu H, I_{B2} = -0.15A, \text{clamped}$		450		V

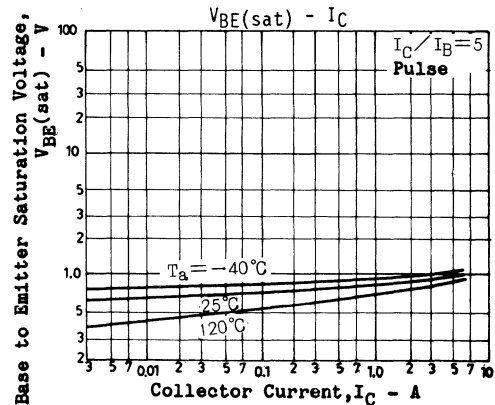
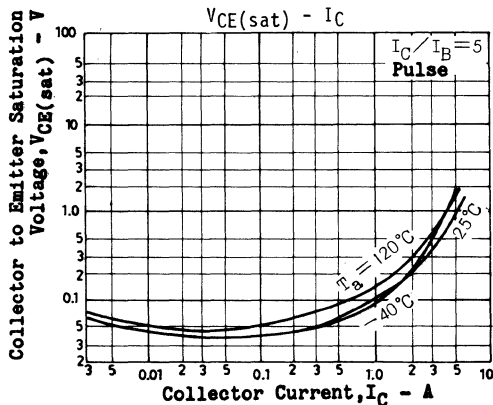
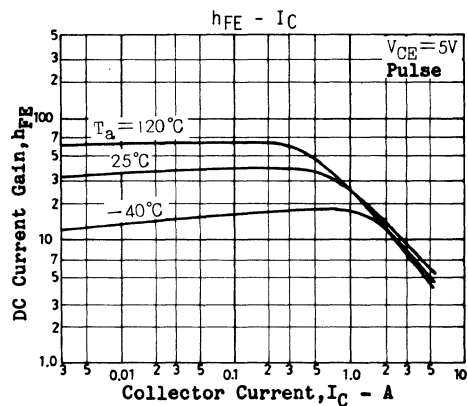
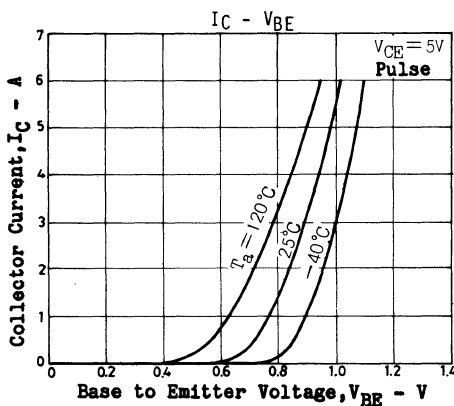
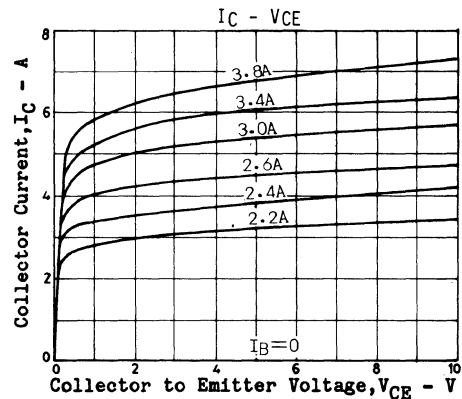
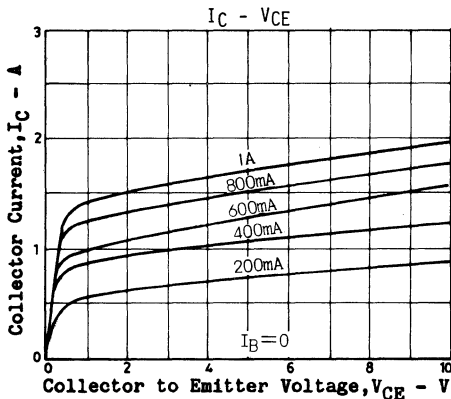
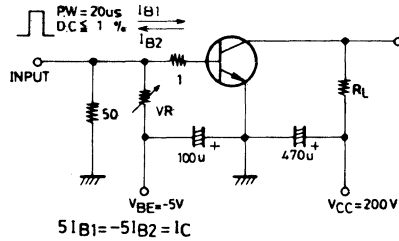
Case Outline 2022

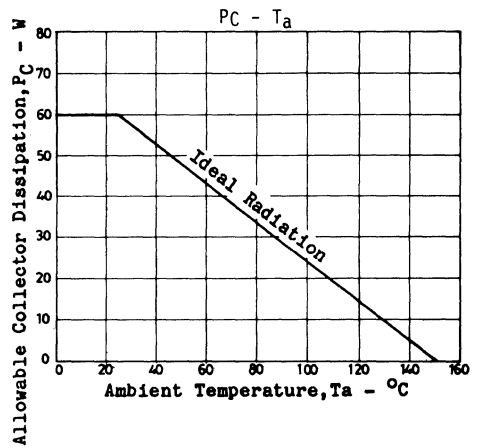
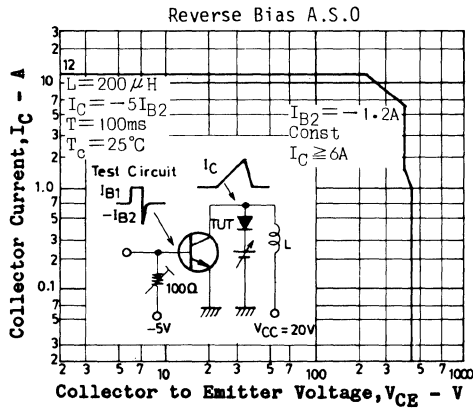
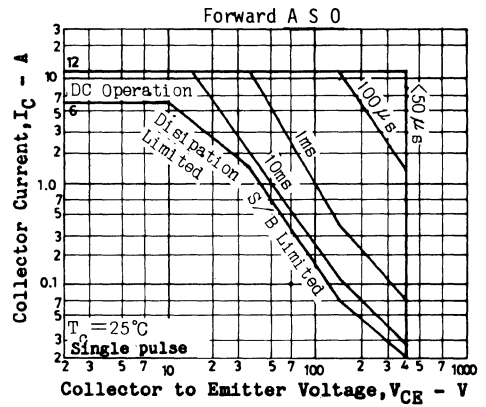
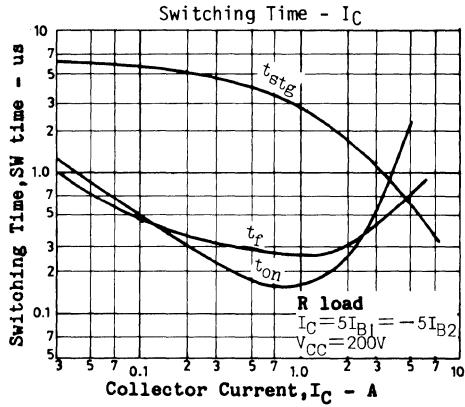
(unit:mm)



			min	typ	max	unit
Turn-ON Time	t_{on}	$I_C=3A, I_{B1}=0.6A, I_{B2}=-0.6A,$ $R_L=66.6\Omega, V_{CC}=200V$			1.0	us
Storage Time	t_{stg}	"			2.5	us
Fall Time	t_f	"			1.0	us

Switching Time Test Circuit





2SC3085



2017

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1055

Features

- . High breakdown voltage($V_{CBO} \geq 500V$)
- . Fast switching speed.
- . Wide ASO.

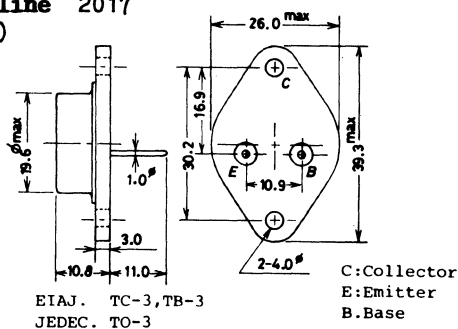
Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	500	V
Collector to Emitter Voltage	V_{CEO}	400	V
Emitter to Base Current	V_{EBO}	7	V
Collector Current	I_C	25	A
Peak Collector Current	i_{cp}	40	A
		$PW \leq 300\mu s,$ $Duty\ Cycle \leq 10\%$	
Base Current	I_B	8	A
Collector Dissipation	P_C	160	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a = 25^\circ C$

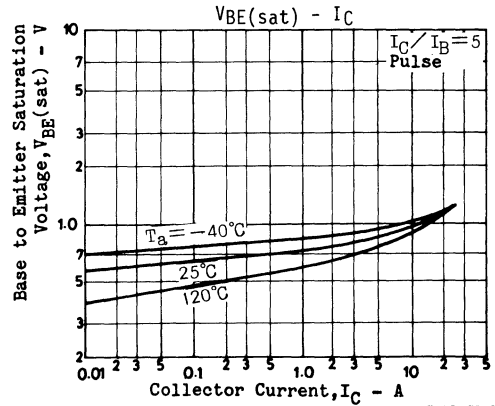
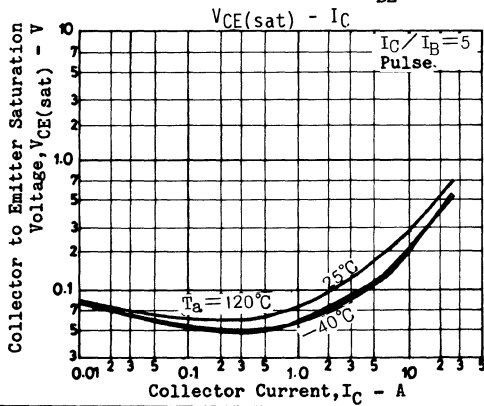
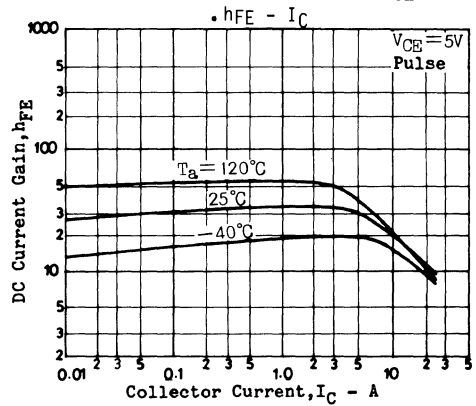
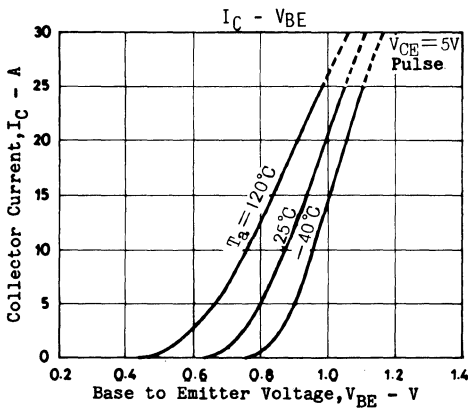
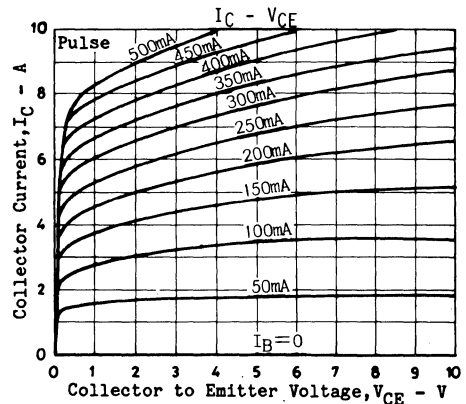
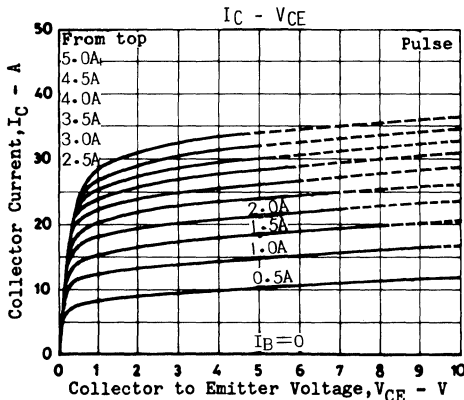
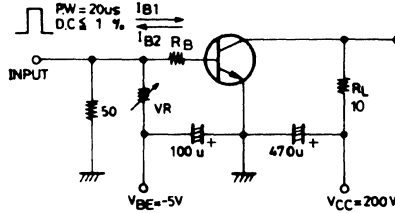
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = 400V, I_E = 0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 5V, I_C = 0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = 5V, I_C = 3.2A$	15			
	$h_{FE}(2)$	$V_{CE} = 5V, I_C = 16A$	8			
Gain Bandwidth Product	f_T	$V_{CE} = 10V, I_C = 3.2A$		20		MHz
Output Capacitance	c_{ob}	$V_{CB} = 10V, f = 1MHz$		320		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = 16A, I_B = 3.2A$			1.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = 16A, I_B = 3.2A$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 1mA, I_E = 0$	500			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 10mA, R_{BE} = \infty$	400			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 1mA, I_C = 0$	7			V
C-E Sustain Voltage	$V_{CEO(sus)}$	$I_C = 25A, L = 50\mu H, I_B = 5A$	400			V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 25A, I_{B1} = 5A, L = 200\mu H,$	400			V
	(1)	$I_{B2} = -5A, \text{clamped}$				
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 6A, I_{B1} = 1.2A, L = 200\mu H,$	450			V
	(2)	$I_{B2} = -1.2A, \text{clamped}$				

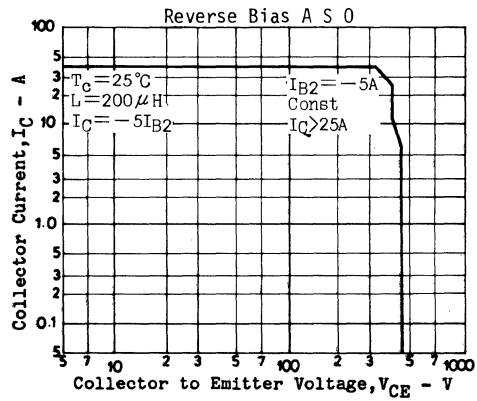
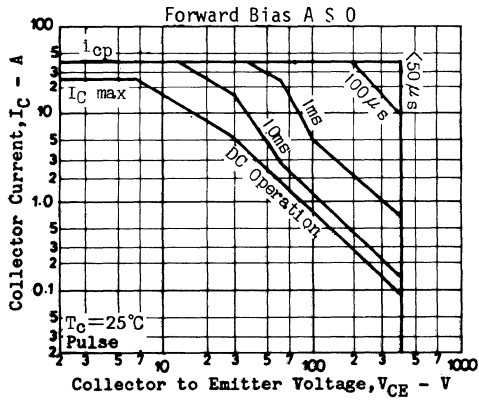
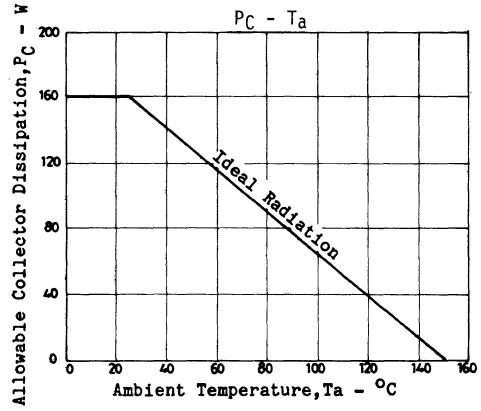
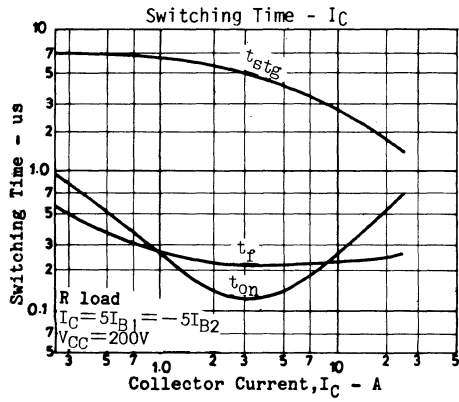
Case Outline 2017 (unit:mm)



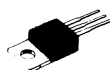
2125MY, TS No.1055-1/3

			min	typ	max	unit
Turn-ON Time	t_{on}	$I_C=20A, I_{B1}=4A, I_{B2}=-4A,$ $R_L=10\Omega, V_{CC}=200V$			1.0	us
Storage Time	t_{stg}	" "			2.5	us
Fall Time	t_f	" "			1.0	us

Switching Time Test Circuit



2SC3086



2010A

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1010A

Features

- . High breakdown voltage($V_{CB0} \geq 800V$)
- . Fast switching speed.
- . Wide ASO.

Absolute Maximum Ratings at $T_a = 25^\circ C$

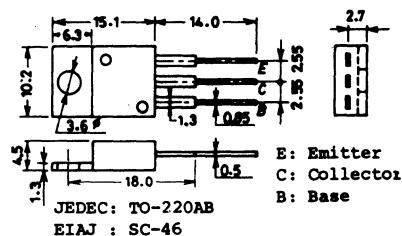
			unit
Collector to Base Voltage	V_{CB0}	800	V
Collector to Emitter Voltage	V_{CEO}	500	V
Emitter to Base Current	V_{EBO}	7	V
Collector Current	I_C	3	A
Peak Collector Current	i_{cp}	$PW \leq 300\mu s,$ Duty Cycle $\leq 10\%$	6 A
Base Current	I_B	1	A
Collector Dissipation	P_C	1.75	W
		$T_c = 25^\circ C$	40 W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = 500V, I_E = 0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 5V, I_C = 0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = 5V, I_C = 0.3A$		10		
	$h_{FE}(2)$	$V_{CE} = 5V, I_C = 1.5A$		8		
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = 1.5A, I_B = 0.3A$			1.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = 1.5A, I_E = 0.3A$			1.5	V
Gain Bandwidth Product	f_T	$V_{CE} = 10V, I_C = 0.3A$		18		MHz
Output Capacitance	c_{ob}	$V_{CB} = 10V, f = 1MHz$		40		pF
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C = 1mA, I_E = 0$		800		V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_C = 1mA, R_{BE} = \infty$		500		V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E = 1mA, I_C = 0$		7		V
C-E Sustain Voltage	$V_{CEO(sus)}$	$I_C = 3A, I_B = 0.6A, L = 50\mu H$		500		V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 3A, I_{B1} = 0.6A, L = 200\mu H,$ $I_{B2} = -0.6A, \text{clamped}$		500		V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 0.6A, I_{B1} = 0.12A, L = 200\mu H$ $I_{B2} = -0.12A, \text{clamped}$	550			V

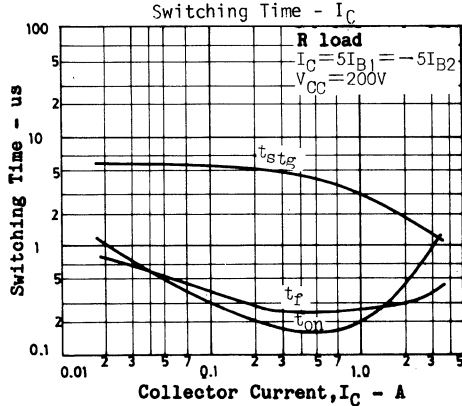
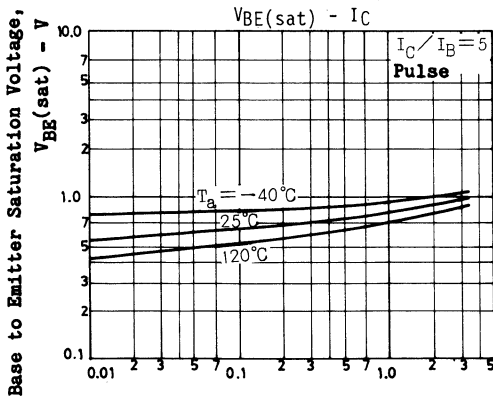
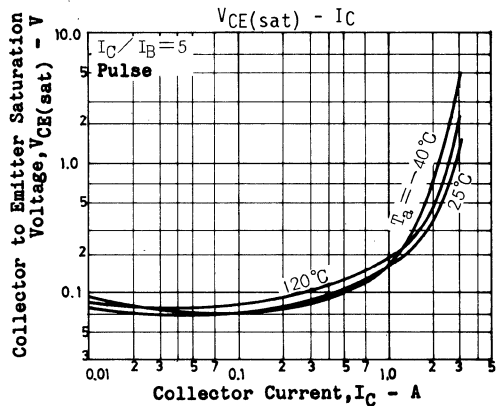
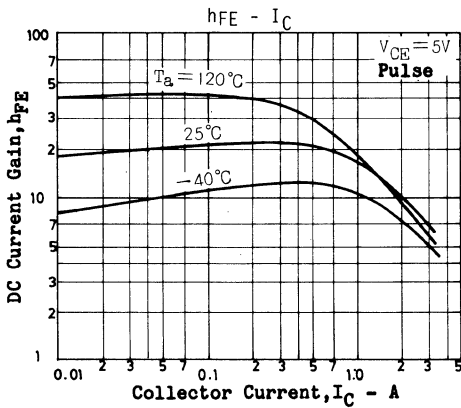
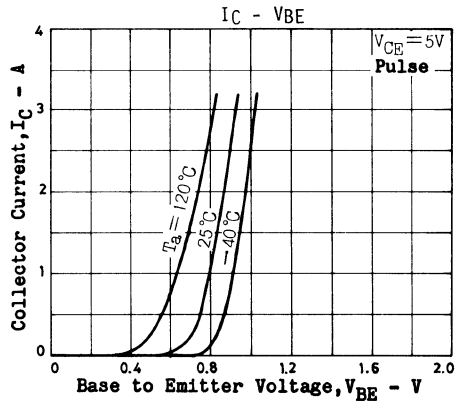
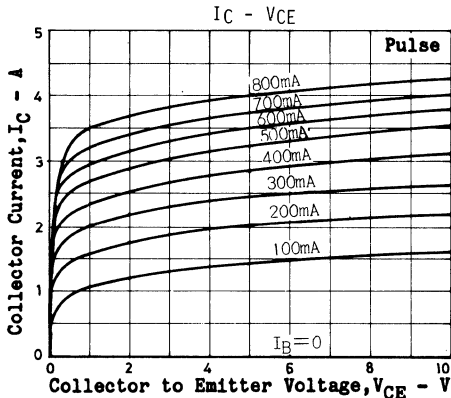
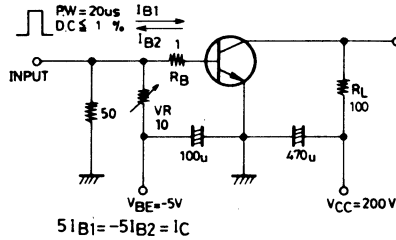
Case Outline 2010A

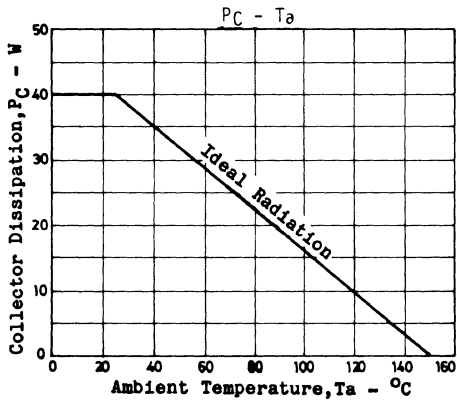
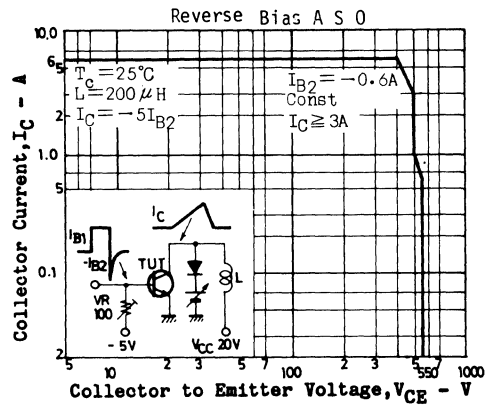
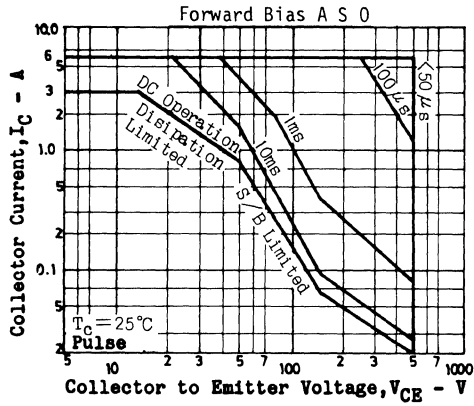
(unit:mm)



			min	typ	max	unit
Turn-ON Time	t_{on}	$I_C=2A, I_{B1}=0.4A, I_{B2}=-0.4A,$ $R_L=100\Omega, V_{CC}=200V$			1.0	us
Storage Time	t_{stg}	"			3.0	us
Fall Time	t_f	"			1.0	us

Switching Time Test Circuit





2SC3087



2010A

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1011A

Features

- High breakdown voltage ($V_{CBO} \geq 800V$)
- High switching speed
- Wide ASO

Absolute Maximum Ratings/ $T_a = 25^\circ C$

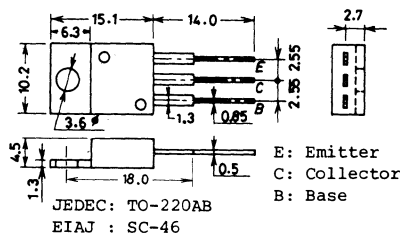
			unit
Collector to base voltage	V_{CBO}	800	V
Collector to emitter voltage	V_{CEO}	500	V
Emitter to base voltage	V_{EBO}	7	V
Collector current	I_C	5	A
Peak collector current	i_{cp}	10	A
		$PW \leq 300 \mu s,$ Duty Cycle $\leq 10\%$	
Base current	I_B	2	A
Collector dissipation	P_C	1.75	W
		$T_C = 25^\circ C$	
Junction temperature	T_j	50	W
Storage temperature	T_{stg}	150	$^\circ C$
		$-55 \sim +150$	
			$^\circ C$

Electrical Characteristics/ $T_a = 25^\circ C$

			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = 500 V, I_E = 0$			10	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = 5 V, I_C = 0$			10	μA
DC current gain	$h_{FE}(1)$	$V_{CE} = 5 V, I_C = 0.6 A$	10			
	$h_{FE}(2)$	$V_{CE} = 5 V, I_C = 3 A$	8			
Collector to emitter saturation voltage	$V_{CE(sat)}$	$I_C = 3 A, I_B = 0.6 A$			1.0	V
Base to emitter saturation voltage	$V_{BE(sat)}$	$I_C = 3 A, I_B = 0.6 A$			1.5	V
Gain bandwidth product	f_T	$V_{CE} = 10 V, I_C = 0.6 A$		18		MHz
Common base output capacitance	c_{ob}	$V_{CB} = 10 V, f = 1 MHz$		80		pF
Collector to base breakdown voltage	$V_{(BR)CBO}$	$I_C = 1 mA, I_E = 0$	800			V
Collector to emitter breakdown voltage	$V_{(BR)CEO}$	$I_C = 4 mA, R_{BE} = \infty$	500			V
Emitter to base breakdown voltage	$V_{(BR)EBO}$	$I_E = 1 mA, I_C = 0$	7			V
Collector to emitter sustaining voltage	$V_{CEO(sus)}$	$I_C = 5 A, L = 50 \mu H, I_B = 1 A$	500			V
Collector to emitter sustaining voltage	$V_{CEX(sus)}$	$I_C = 5 A, L = 200 \mu H, I_{B1} = -I_{B2}$	500			V
	(1)	$= 1 A, \text{clamped}$				
Collector to emitter sustaining voltage	$V_{CEX(sus)}$	$I_C = 1.2 A, L = 200 \mu H, I_{B1} = 0.24 A$	550			V
	(2)	$I_{B2} = -0.24 A, \text{clamped}$				

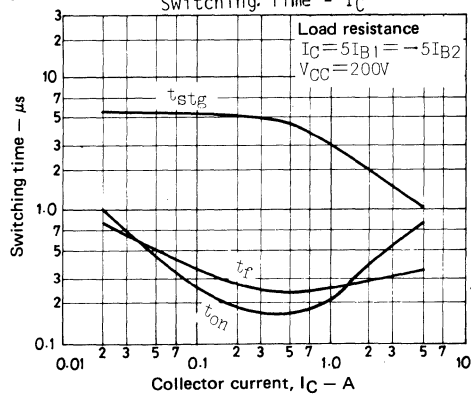
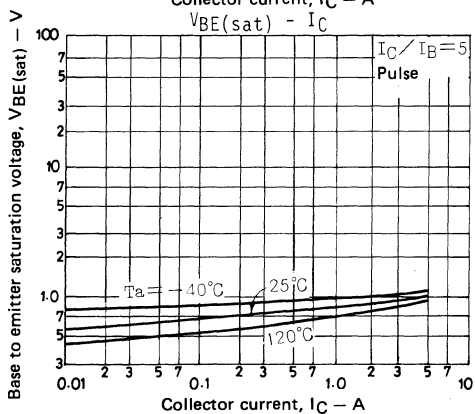
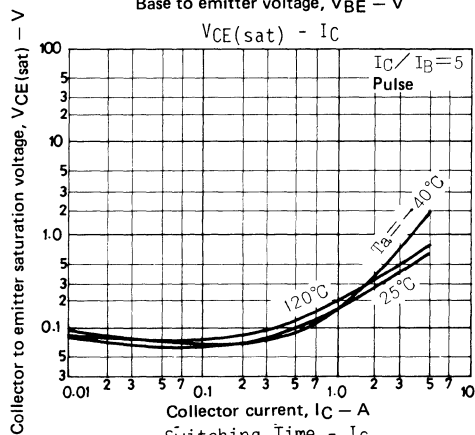
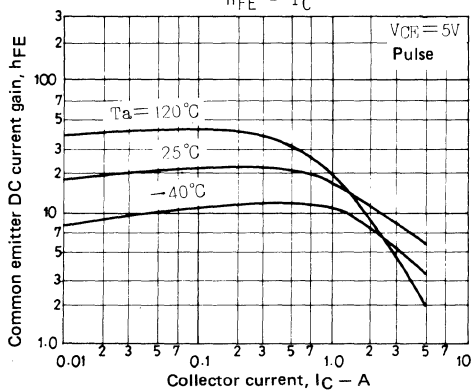
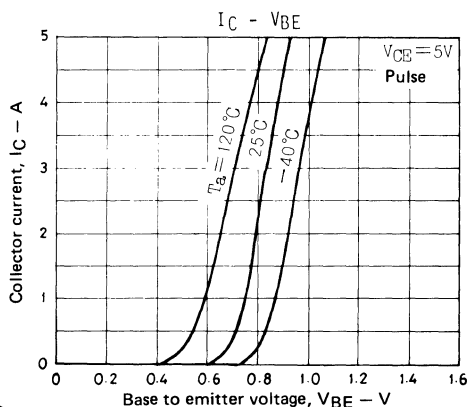
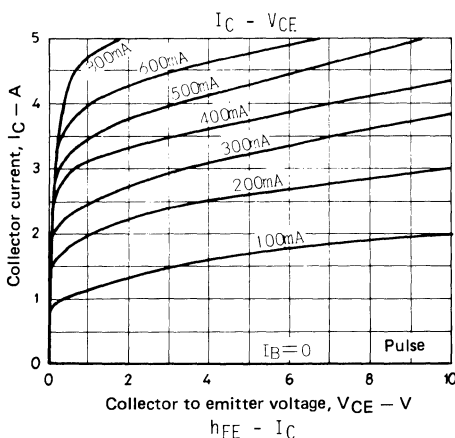
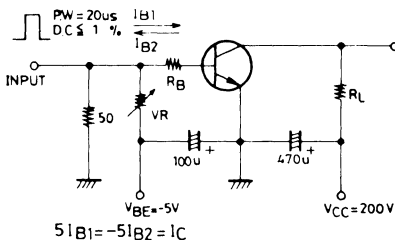
Case Outline 2010A

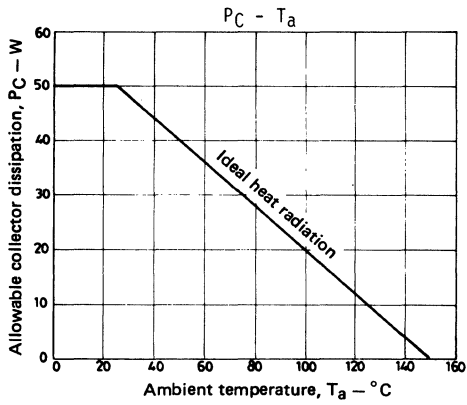
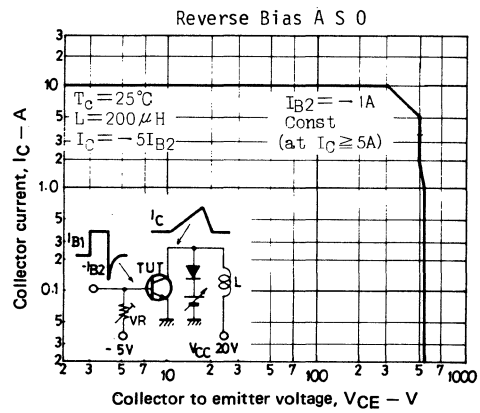
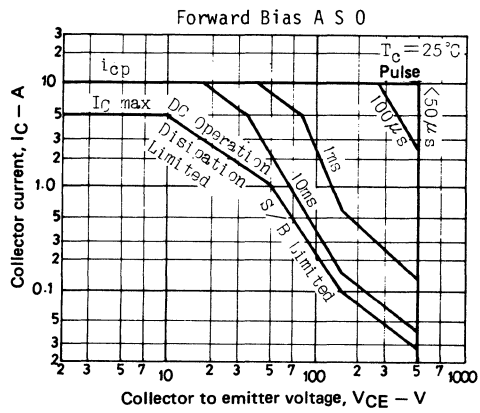
(unit: mm)



			min	typ	max	unit
Turn-on time	t_{on}	$I_C = 4\text{ A}$, $I_{B1} = 0.8\text{ A}$, $I_{B2} = -0.8\text{ A}$, $R_L = 50\ \Omega$, $V_{CC} = 200\text{ V}$			1.0	μs
Storage time	t_{stg}	$I_C = 4\text{ A}$, $I_{B1} = 0.8\text{ A}$, $I_{B2} = -0.8\text{ A}$, $R_L = 50\ \Omega$, $V_{CC} = 200\text{ V}$			3.0	μs
Fall time	t_f	$I_C = 4\text{ A}$, $I_{B1} = 0.8\text{ A}$, $I_{B2} = -0.8\text{ A}$, $R_L = 50\ \Omega$, $V_{CC} = 200\text{ V}$			1.0	μs

Switching Time Test Circuit





2SC3088



2022

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1017A

Features

- High breakdown voltage($V_{CBO} \geq 800V$)
- Fast switching speed.
- Wide ASO.

Absolute Maximum Ratings at $T_a = 25^\circ C$

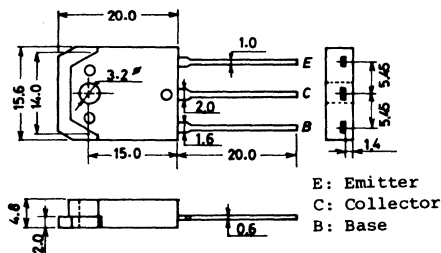
			unit
Collector to Base Voltage	V_{CBO}	800	V
Collector to Emitter Voltage	V_{CEO}	500	V
Emitter to Base Current	V_{EBO}	7	V
Collector Current	I_C	4	A
Peak Collector Current	i_{cp}	8	A
	$PW \leq 300\mu s,$ Duty Cycle $\leq 10\%$		
Base Current	I_B	1.5	A
Collector Dissipation	P_C	2.5	W
	$T_c = 25^\circ C$	60	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = 500V, I_E = 0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 5V, I_C = 0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = 5V, I_C = 0.3A$	10			
	$h_{FE}(2)$	$V_{CE} = 5V, I_C = 1.5A$	8			
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = 1.5A, I_B = 0.3A$			1.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = 1.5A, I_B = 0.3A$			1.5	V
Gain Bandwidth Product	f_T	$V_{CE} = 10V, I_C = 0.3A$		18		MHz
Output Capacitance	c_{ob}	$V_{CB} = 10V, f = 1MHz$		40		pF
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 1mA, I_E = 0$		800		V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 1mA, R_{BE} = \infty$		500		V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 1mA, I_C = 0$		7		V
C-E Sustain Voltage	$V_{CEO(sus)}$	$I_C = 4A, I_B = 0.8A, L = 50\mu H$		500		V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 4A, I_{B1} = 0.8A, L = 200\mu H,$ $I_{B2} = -0.8A, \text{clamped}$		500		V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 0.6A, I_{B1} = 0.12A, L = 200\mu H$ $I_{B2} = -0.12A, \text{clamped}$		550		V

Case Outline 2022

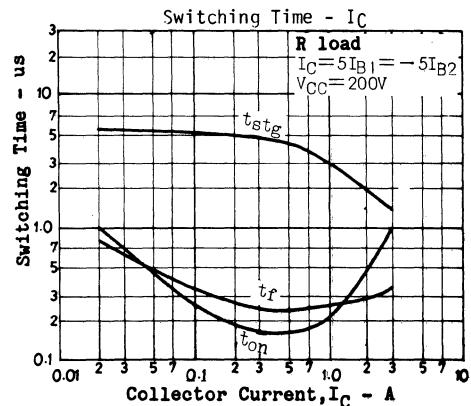
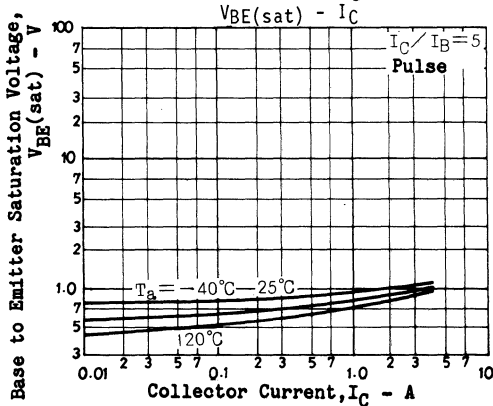
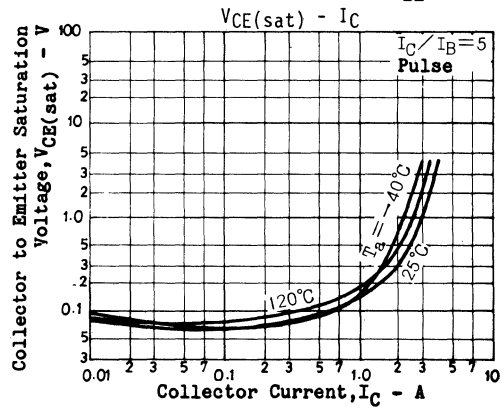
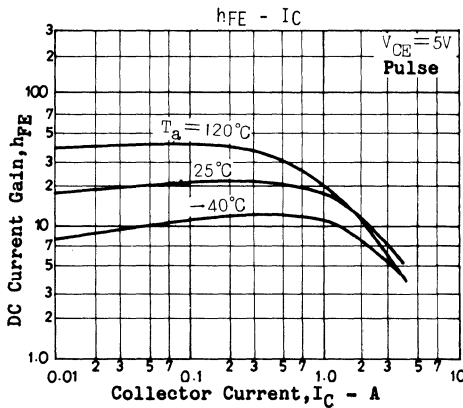
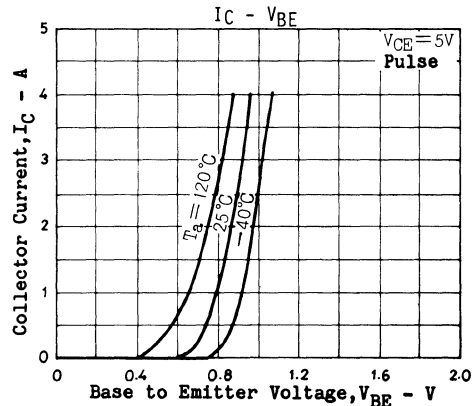
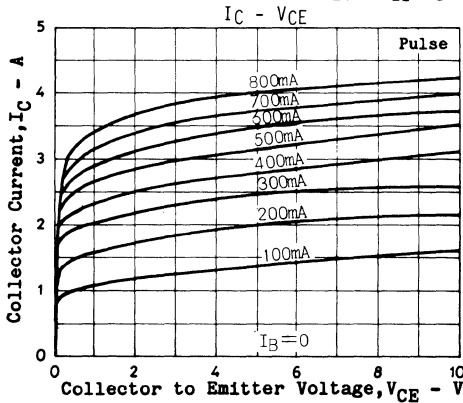
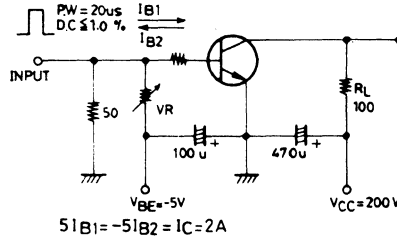
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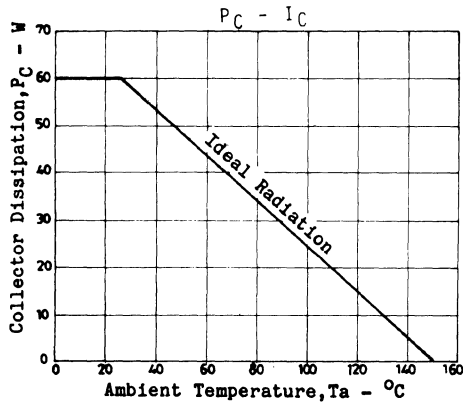
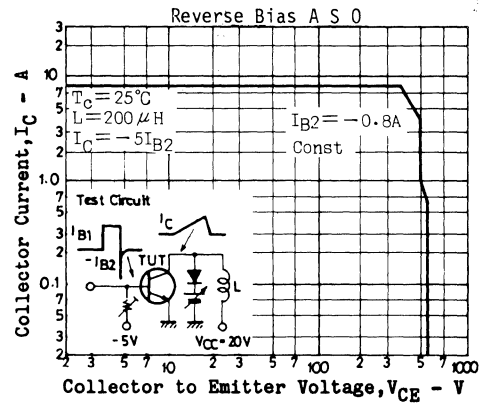
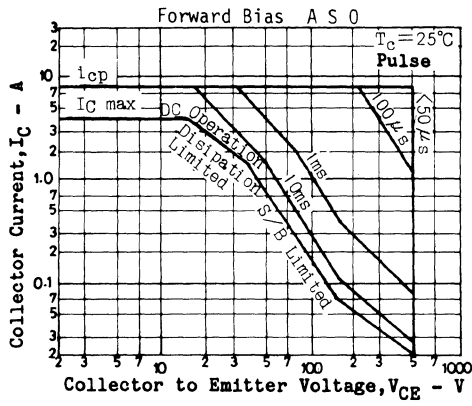


3095MY, TS No.1017-1/3

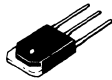
			min	typ	max	unit
Turn-ON Time	t_{on}	$I_C=2A, I_{B1}=0.4A, I_{B2}=-0.4A,$ $R_L=100\Omega, V_{CC}=200V$			1.0	us
Storage Time	t_{stg}	"			3.0	us
Fall Time	t_f	"			1.0	us

Switching Time Test Circuit





2SC3089



2022

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1012A

Features

- High breakdown voltage($V_{CB0} \geq 800V$)
- Fast switching speed.
- Wide ASO.

Absolute Maximum Ratings at $T_a = 25^\circ C$

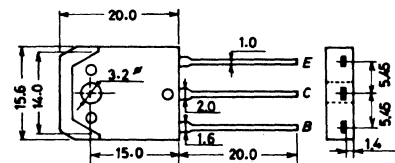
		unit
Collector to Base Voltage	V_{CB0}	800 V
Collector to Emitter Voltage	V_{CE0}	500 V
Emitter to Base Current	V_{EBO}	7 V
Collector Current	I_C	7 A
Peak Collector Current	i_{cp}	14 A
	$PW \leq 300\mu s,$ $Duty Cycle \leq 10\%$	
Base Current	I_B	3 A
Collector Dissipation	P_C	2.5 W
	$T_c = 25^\circ C$	80 W
Junction Temperature	T_j	150 $^\circ C$
Storage Temperature	T_{stg}	-55 to +150 $^\circ C$

Electrical Characteristics at $T_a = 25^\circ C$

		min	typ	max	unit
Collector Cutoff Current	I_{CBO}			10	μA
Emitter Cutoff Current	I_{EBO}			10	μA
DC Current Gain	$h_{FE}(1)$		10		
	$h_{FE}(2)$		8		
C-E Saturation Voltage	$V_{CE(sat)}$			1.0	V
B-E Saturation Voltage	$V_{BE(sat)}$			1.5	V
Gain Bandwidth Product	f_T		18		MHz
Output Capacitance	c_{ob}		80		pF
C-B Breakdown Voltage	$V_{(BR)CBO}$		800		V
C-E Breakdown Voltage	$V_{(BR)CEO}$		500		V
E-B Breakdown Voltage	$V_{(BR)EBO}$		7		V
C-E Sustain Voltage	$V_{CEO(sus)}$		500		V
C-E Sustain Voltage	$V_{CEX(sus)}$		500		V
	(1)				
C-E Sustain Voltage	$V_{CEX(sus)}$		550		V
	(2)				

Case Outline 2022

(unit:mm)

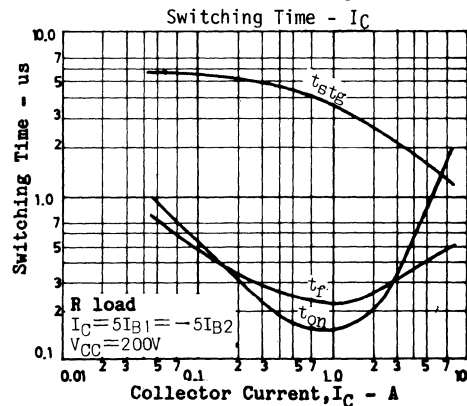
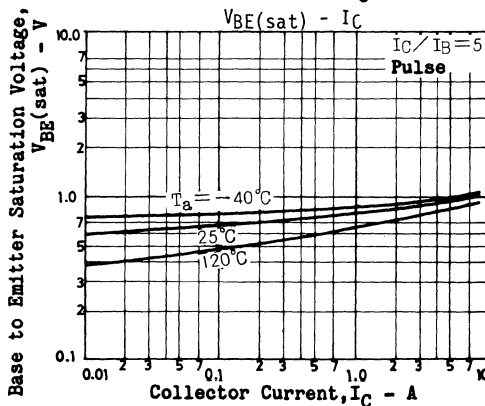
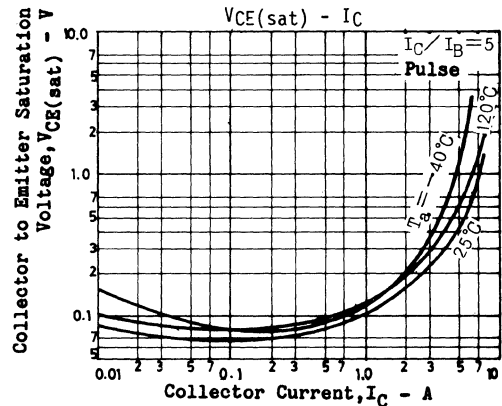
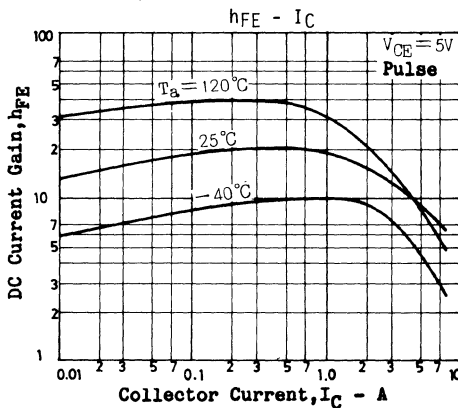
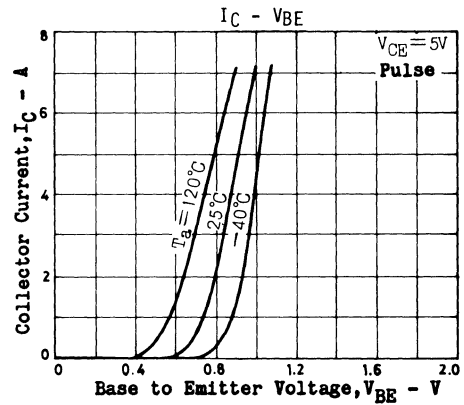
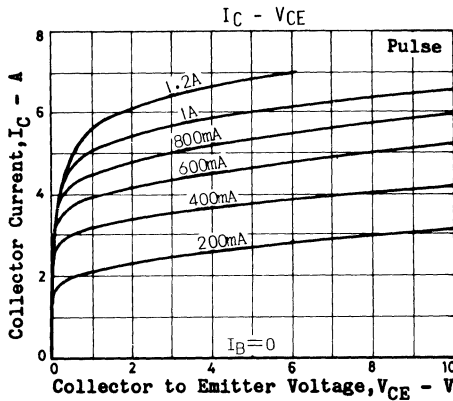
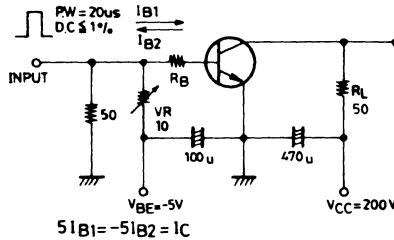


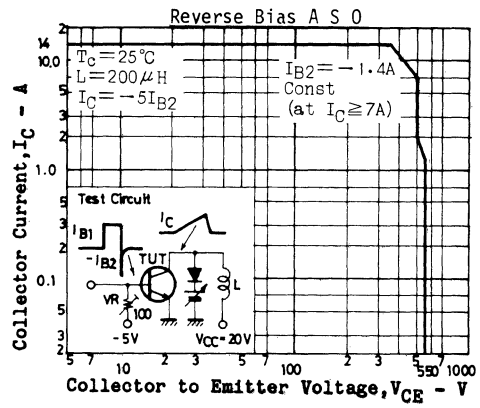
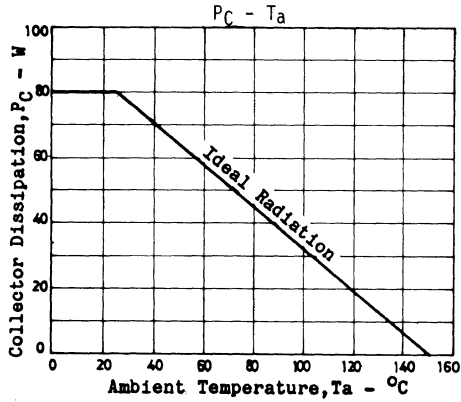
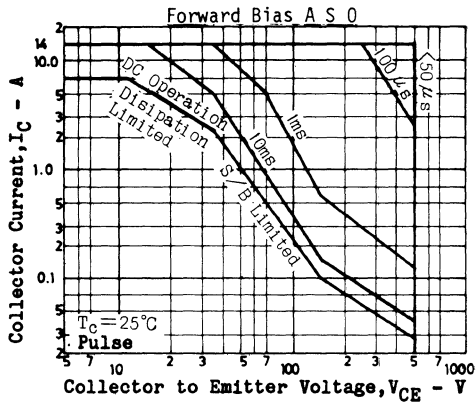
E: Emitter
C: Collector
B: Base

3095MY, TS No.1012-1/3

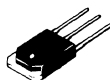
			min	typ	max	unit
Turn-ON Time	t_{on}	$I_C=4A, I_{B1}=0.8A, I_{B2}=-0.8A,$ $R_L=50\Omega, V_{CC}=200V$			1.0	us
Storage Time	t_{stg}	"			3.0	us
Fall Time	t_f	"			1.0	us

Switching Time Test Circuit





2SC3090



2022

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1013A

Features

- . High breakdown voltage($V_{CB0} \geq 800V$).
- . Fast switching speed.
- . High ASO.

Absolute Maximum Ratings at $T_a = 25^\circ C$

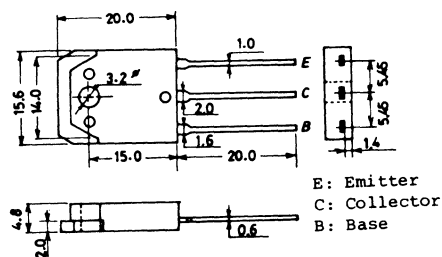
			unit
Collector to Base Voltage	V_{CB0}	800	V
Collector to Emitter Voltage	V_{CE0}	500	V
Emitter to base Current	V_{EB0}	7	V
Collector Current	I_C	10	A
Peak collector Current	i_{cp}	20	A
		Pulse, $PW \leq 300\mu s$, Duty Cycle $\leq 10\%$	
Base Current	I_B	4	W
Collector Dissipation	P_C	2.5	W
		$T_c = 25^\circ C$	
		100	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB} = 500V, I_E = 0$			10	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB} = 5V, I_C = 0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = 5V, I_C = 1.2A$	10			
	$h_{FE}(2)$	$V_{CE} = 5V, I_C = 6A$	8			
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = 6A, I_B = 1.2A$			1.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = 6A, I_B = 1.2A$			1.5	V
Gain Bandwidth Product	f_T	$V_{CE} = 10V, I_C = 1.2A$		18		MHz
Output Capacitance	c_{od}	$V_{CB} = 10V, f = 1MHz$		160		pF
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 1mA, I_E = 0$		800		V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 5mA, R_{BE} = \infty$		500		V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 1mA, I_C = 0$		7		V
C-E Sustain Voltage	$V_{CE0(sus)}$	$I_C = 10A, I_B = 2A, L = 50\mu H$		500		V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 10A, I_{B1} = 2A, L = 200\mu H$		500		V
	(1)	$I_{B2} = -2A, \text{clamped}$				
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 2.4A, I_{B1} = 0.48A, L = 200\mu H$		550		V
	(2)	$I_{B2} = -0.48A, \text{clamped}$				

Case Outline 2022

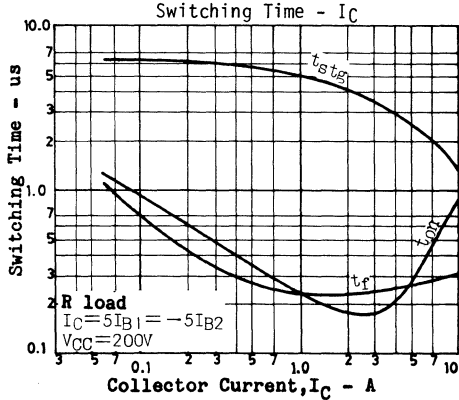
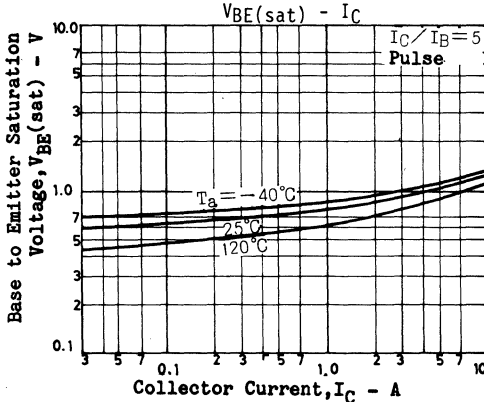
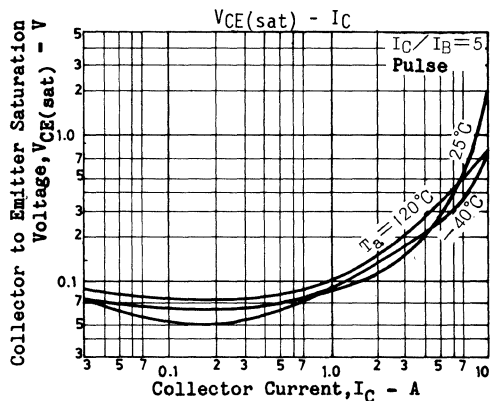
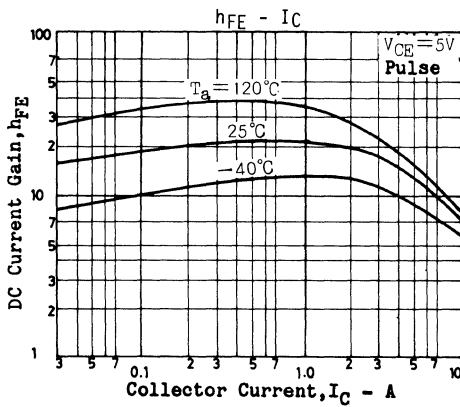
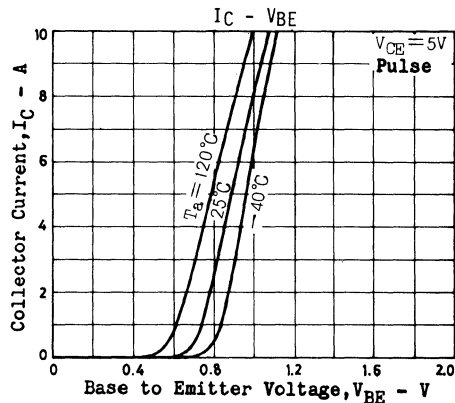
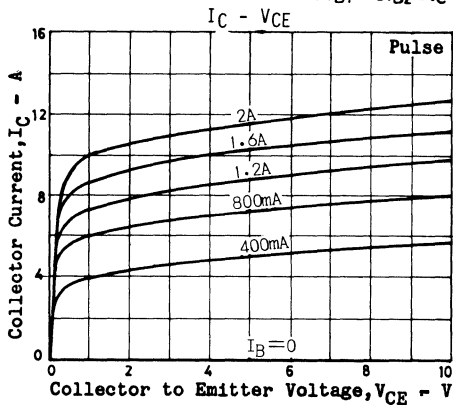
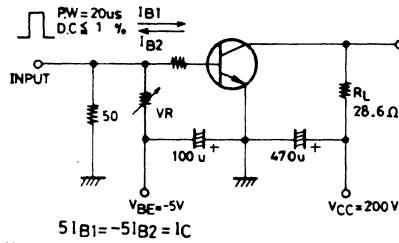
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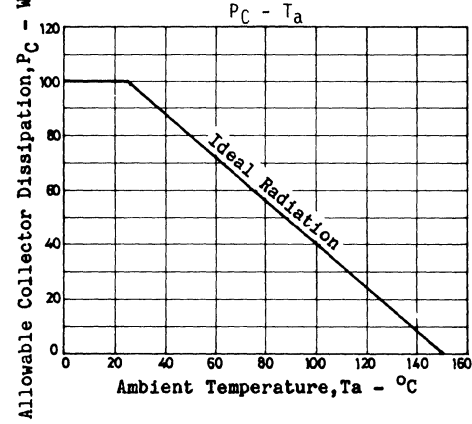
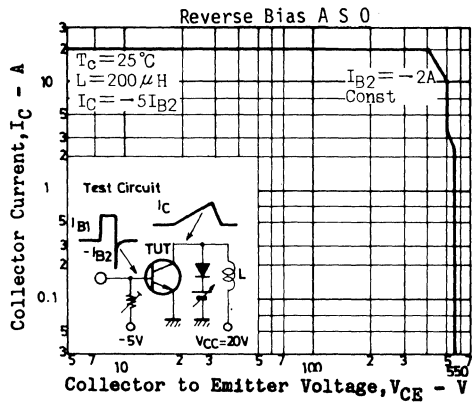
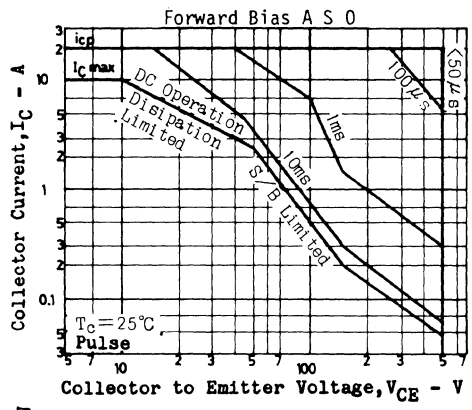


2125MY, TS No.1013-1/3

			min	typ	max	unit
Turn-ON Time	t_{on}	$I_C=7A, I_{B1}=0.14A, I_{B2}=-0.14A,$ $R_L=28.6\Omega, V_{CC}=200V$			1.0	us
Storage Time	t_{stg}	"			3.0	us
Fall Time	t_f	"			1.0	us

Switching Time Test Circuit





2SC3114



2003A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1246

Low Frequency, General-Purpose Amp Applications

©1047A

Features

- High V_{EBO}
- Wide ASO and highly resistant to breakdown

(): 2SA1246

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Collector to base voltage	V_{CBO}	(-) 60	V
Collector to emitter voltage	V_{CEO}	(-) 50	V
Emitter to base voltage	V_{EBO}	(-) 15	V
Collector current	I_C	(-) 150	mA
Peak collector current	i_{cp}	(-) 300	mA
Collector dissipation	P_C	400	mW
Junction temperature	T_j	150	$^\circ\text{C}$
Storage temperature	T_{stg}	$-55 \sim +150$	$^\circ\text{C}$

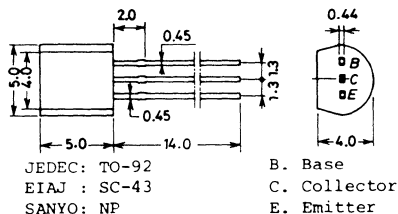
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

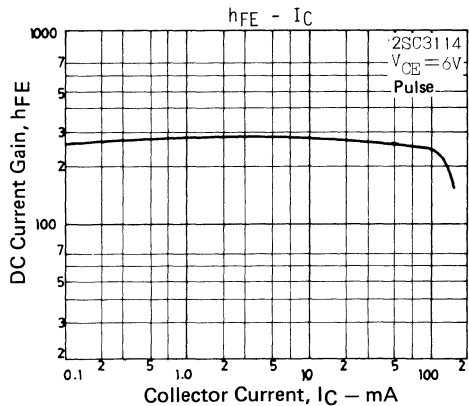
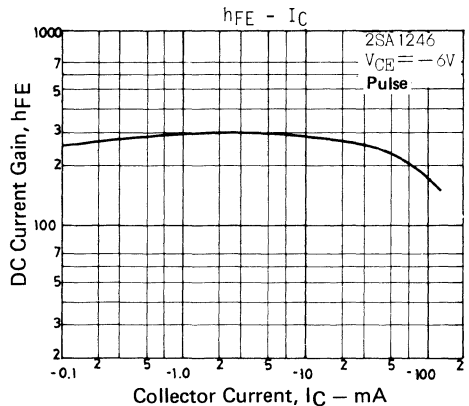
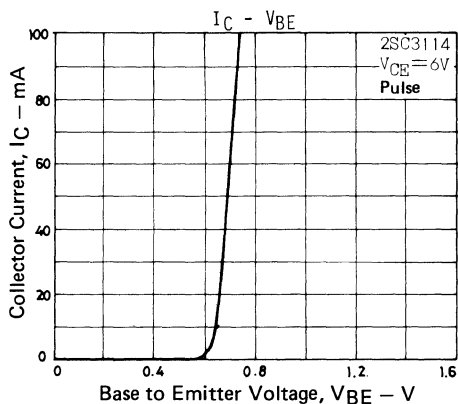
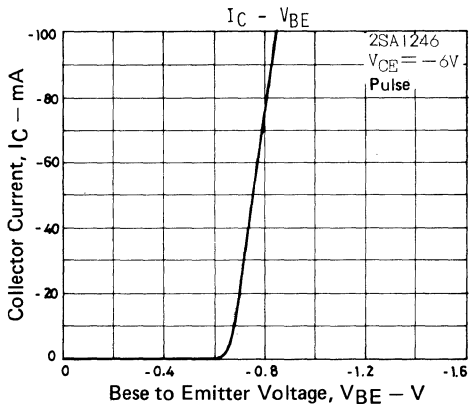
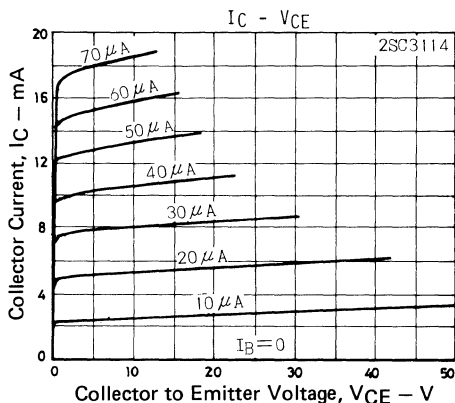
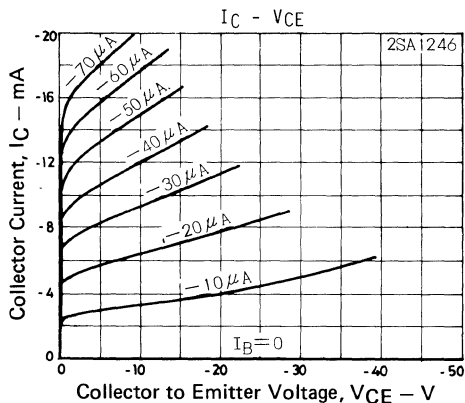
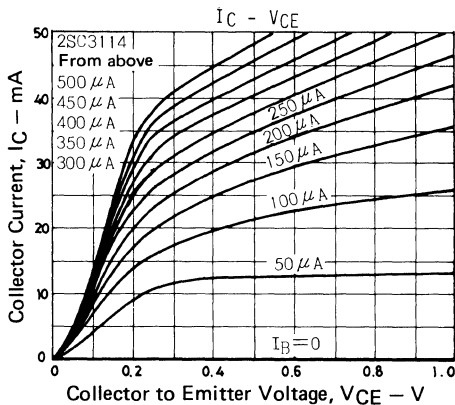
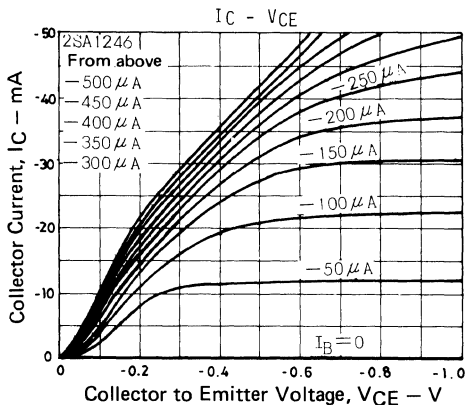
			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB}=(-)40\text{ V}, I_E=0$			(-) 0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB}=(-)10\text{ V}, I_C=0$			(-) 0.1	μA
DC current gain	h_{FE}	$V_{CE}=(-)6\text{ V}, I_C=(-)1\text{ mA}$	100^*		560^*	
Gain bandwidth product	f_T	$V_{CE}=(-)6\text{ V}, I_C=(-)1\text{ mA}$		100		MHz
Common base output capacitance	c_{ob}	$V_{CB}=(-)6\text{ V}, f=1\text{ MHz}$		3.0		pF
C-E saturation voltage	$V_{CE(sat)}$	$I_C=(-)50\text{ mA}, I_B=(-)5\text{ mA}$		(4.2)	(-) 0.5	V
C-B breakdown voltage	$V_{(BR)CBO}$	$I_C=(-)10\text{ }\mu\text{A}, I_E=0$	(-) 60			V
C-E breakdown voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{ mA}, R_{BE}=\infty$	(-) 50			V
E-B breakdown voltage	$V_{(BR)EBO}$	$I_E=(-)10\text{ }\mu\text{A}, I_C=0$	(-) 15			V

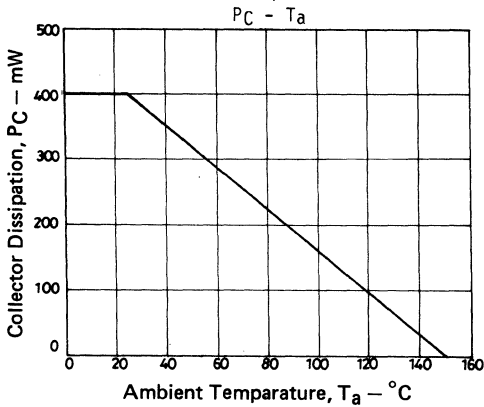
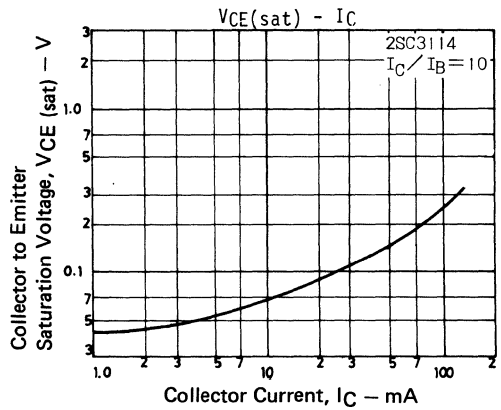
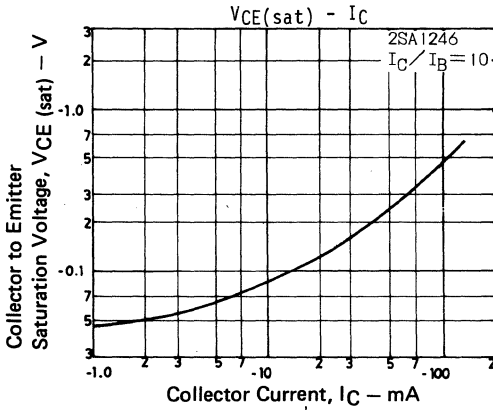
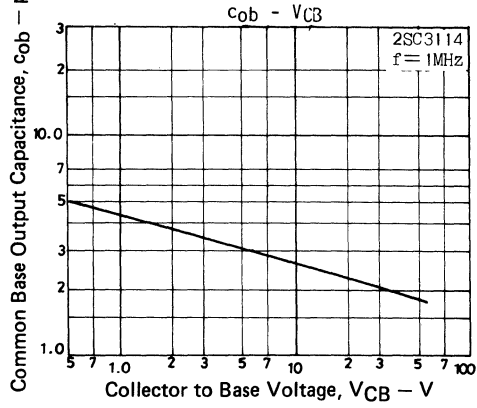
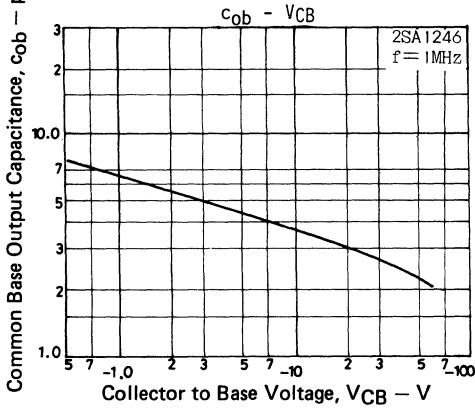
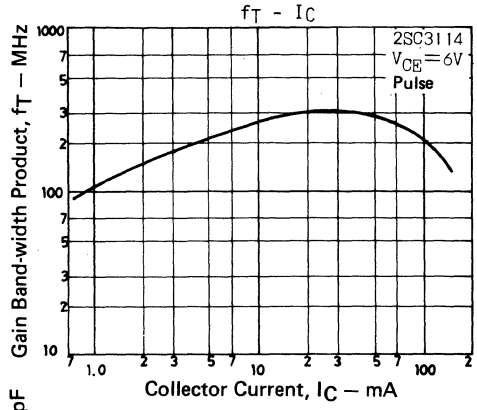
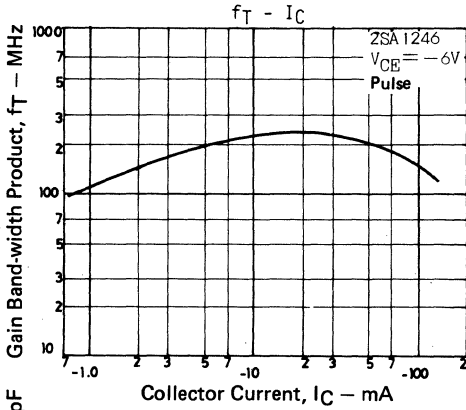
* The 2SA1246/2SC3114 are classified as follows according to h_{FE} at 1 mA.

100 R 200	140 S 280	200 T 400	280 U 560
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Case Outline 2003A (unit: mm)







2SC3116



2009

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1248

High Voltage Switching Applications

©1032

Uses

- Color TV sound output, converters, inverters

Features

- High breakdown voltage
- Large current capacity
- Using MBIT process

(): 2SA1248

Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)180	V
Collector to Emitter Voltage	V_{CE0}	(-)160	V
Emitter to Base Voltage	V_{EB0}	(-)6	V
Collector Current	I_C	(-)0.7	A
Peak Collector Current	i_{cp}	(-)1.5	A
Collector Dissipation	P_C	1	W
		10	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

$T_c=25^{\circ}\text{C}$

Electrical Characteristics/ $T_a=25^{\circ}\text{C}$

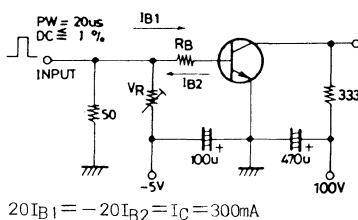
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)120\text{V}, I_E=0$			(-)1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)1.0	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=(-)5\text{V}, I_C=(-)100\text{mA}$	100*		400*	
	$h_{FE}(2)$	$V_{CE}=(-)5\text{V}, I_C=(-)10\text{mA}$	90			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		120		MHz
Common Base Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		8		pF
				(11)		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)250\text{mA}, I_B=(-)25\text{mA}$		0.12	0.4	V
				(-0.2)	(-0.5)	
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)250\text{mA}, I_B=(-)25\text{mA}$		(-)0.85	(-)1.2	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)180			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	(-)160			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$	(-)6			V
Turn-on Time	t_{on}	at Specified Test Circuit		(60)50		ns
Storage Time	t_{stg}	"		(900)1000		ns
Fall Time	t_f	"		(60)60		ns

* The 2SA1248/2SC3116 are classified as follows according to h_{FE} at 100mA.

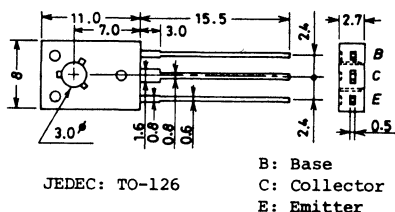
100	R	200	140	S	280	200	T	400
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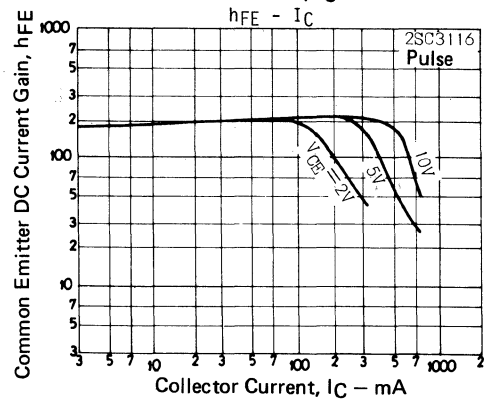
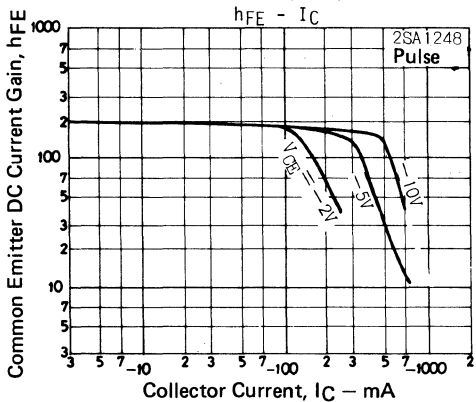
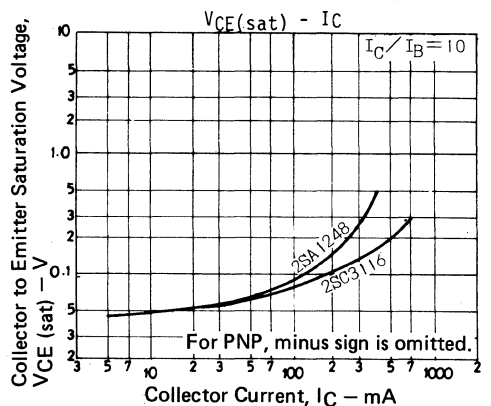
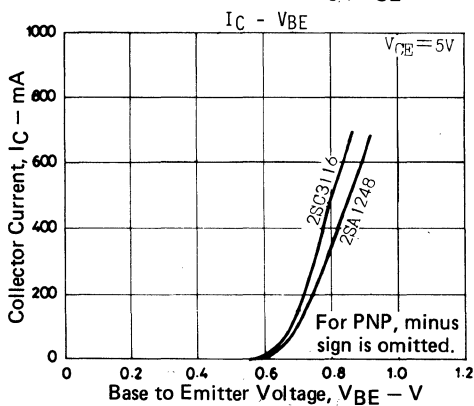
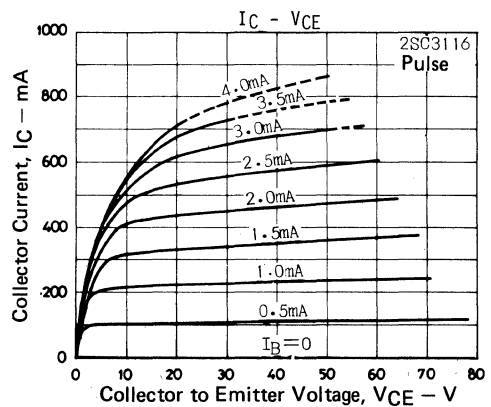
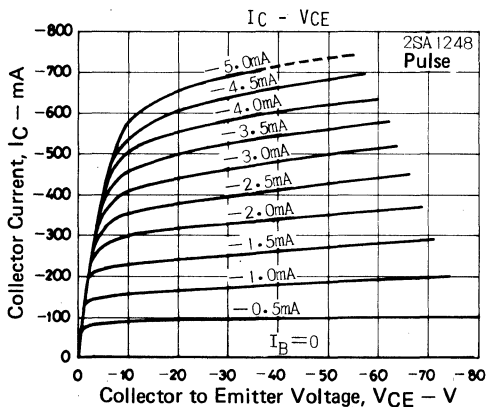
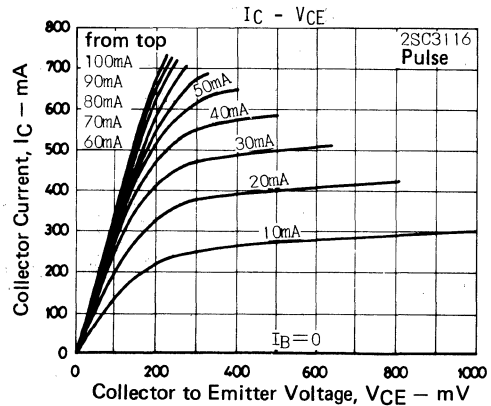
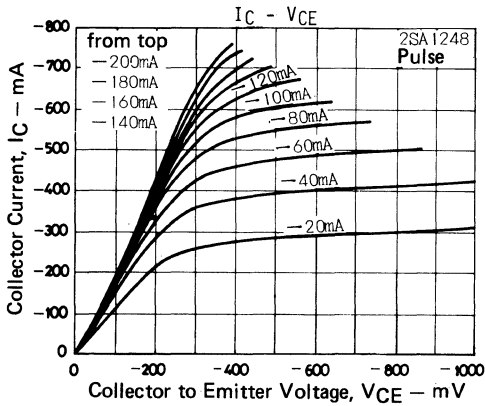
Switching Time Test Circuit

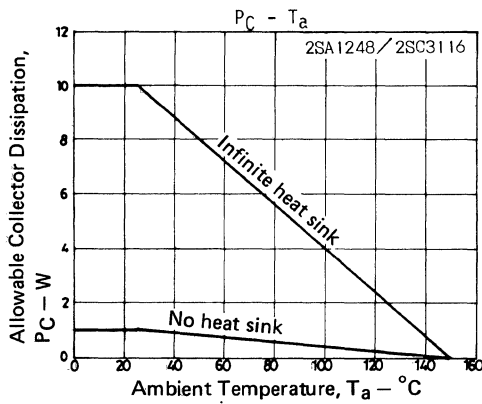
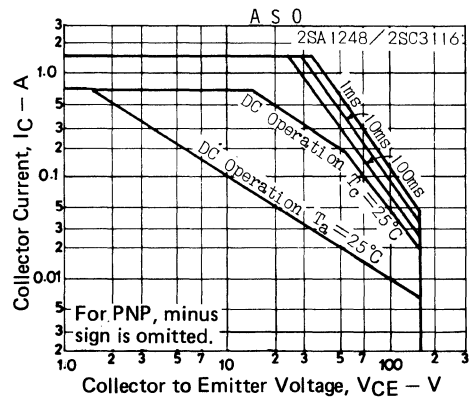
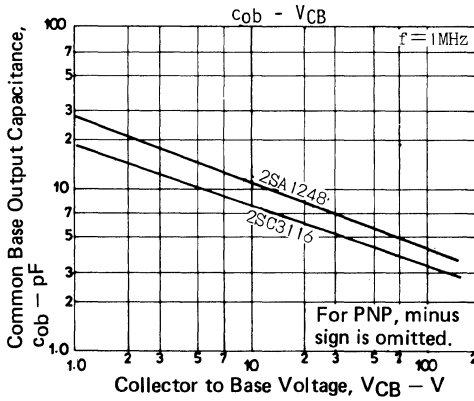
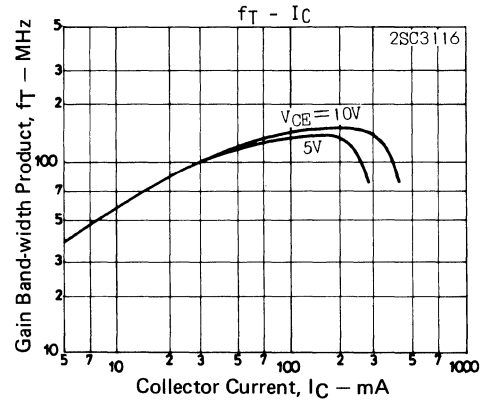
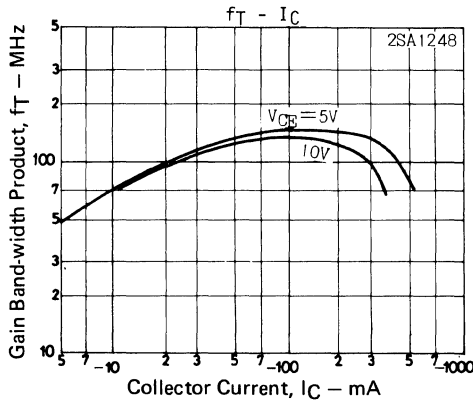
(For PNP, polarity is reversed.)



Case Outline 2009 (unit: mm)







2SC3117



2009

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1249

High Voltage Switching Applications

©1060

Uses

- Color TV sound output, converters, inverters

Features

- High breakdown voltage
- Large current capacity
- Using MBIT process

() : 2SA1249

Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$

Collector to Base Voltage	V_{CBO}	(-) 180	V
Collector to Emitter Voltage	V_{CEO}	(-) 160	V
Emitter to Base Voltage	V_{EBO}	(-) 6	V
Collector Current	I_C	(-) 1.5	A
Peak Collector Current	i_{cp}	(-) 2.5	A
Collector Dissipation	P_C	1	W
		10	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to $+150$	$^{\circ}\text{C}$

$T_C=25^{\circ}\text{C}$

Electrical Characteristics/ $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)120\text{V}, I_E=0$			(-) 1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-) 1.0	μA
Common Emitter DC Current Gain	$h_{FE}(1)$	$V_{CE}=(-)5\text{V}, I_C=(-)100\text{mA}$	100^*		400^*	
	$h_{FE}(2)$	$V_{CE}=(-)5\text{V}, I_C=(-)10\text{mA}$	90			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		120		MHz
Common Base Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(22)		pF
				14		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500\text{mA}, I_B=(-)50\text{mA}$		(-) 0.2	(-) 0.5	V
				0.13	0.45	
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500\text{mA}, I_B=(-)50\text{mA}$		(-) 0.85	(-) 1.2	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$		(-) 180		V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$		(-) 160		V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$		(-) 6		V
Turn-on Time	t_{on}	at Specified Test Circuit		0.04		μs
Storage Time	t_{stg}	"		(0.7) 1.2		μs
Fall Time	t_f	"		(0.04) 0.08		μs

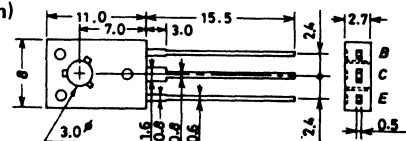
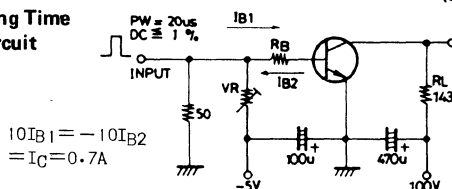
* The 2SA1249/2SC3117 are classified as follows according to h_{FE} at 100mA.

100	R	200	140	S	280	200	T	400
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Case Outline 2009

(unit: mm)

Switching Time Test Circuit



JEDEC: TO-126

B: Base
C: Collector
E: Emitter

D222 K1, III No. 1060-1/1

2SC3134

2018

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1252

Low Frequency, General-Purpose Amp Applications

©1048A

Features

- High V_{EBO} .
- Wide ASO and high durability against breakdown.

() : 2SA1252

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

Collector to Base Voltage	V_{CBO}	(-)60	V
Collector to Emitter Voltage	V_{CEO}	(-)50	V
Emitter to Base Voltage	V_{EBO}	(-)15	V
Collector Current	I_C	(-)150	mA
Peak Collector Current	i_{cp}	(-)300	mA
Collector Dissipation	P_C	200	mW
Junction Temperature	T_j	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +125	$^\circ\text{C}$

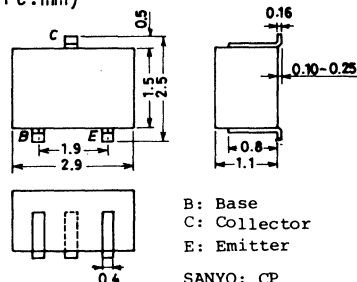
Electrical Characteristics at $T_a=25^\circ\text{C}$

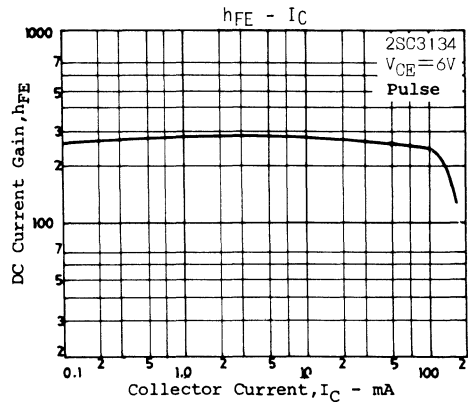
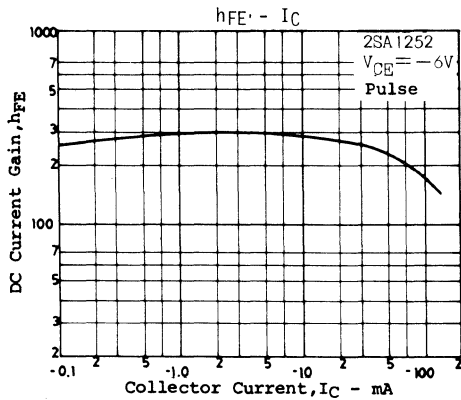
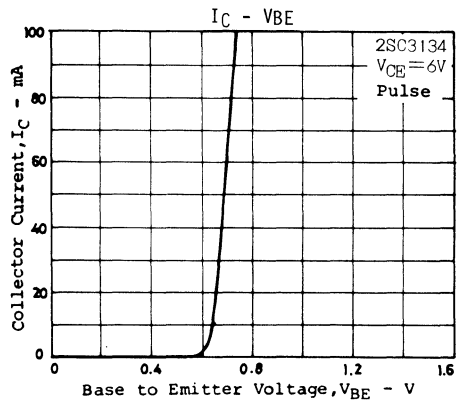
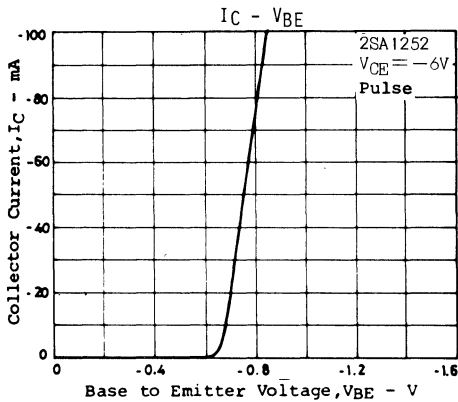
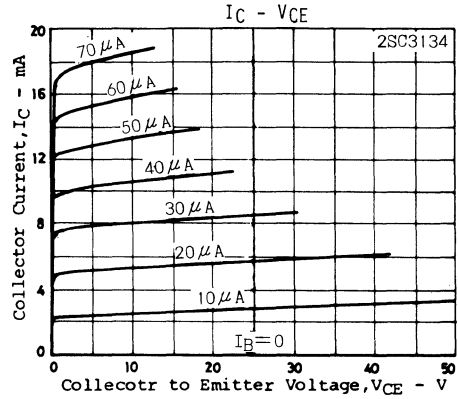
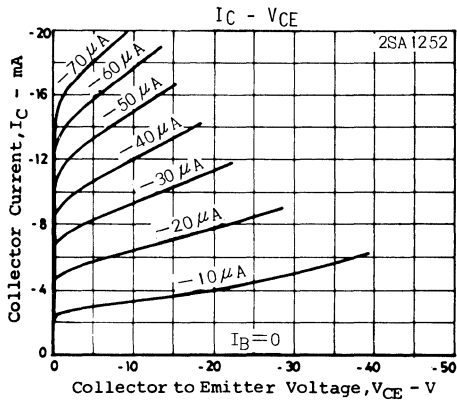
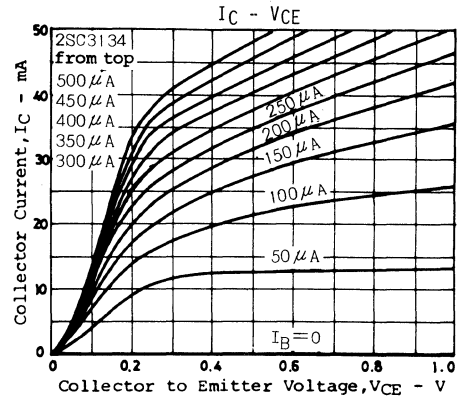
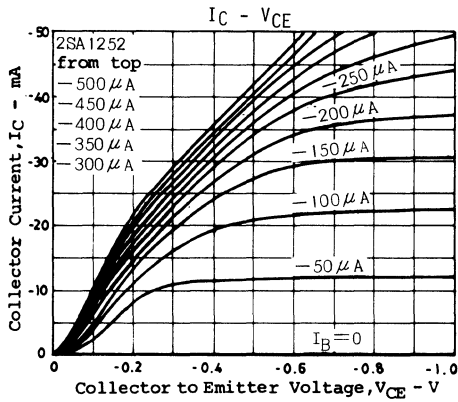
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)10\text{V}, I_C=0$			(-)0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)6\text{V}, I_C=(-)1\text{mA}$	100*		560*	
Gain Bandwidth Product	f_T	$V_{CE}=(-)6\text{V}, I_C=(-)1\text{mA}$		100		MHz
Output Capacitance	C_{ob}	$V_{CB}=(-)6\text{V}, f=1\text{MHz}$		(3.5)		pF
				2.2		
C to E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)50\text{mA}, I_E=(-)5\text{mA}$			(-)0.5	V
C to B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$			(-)60	V
C to E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$			(-)50	V
E to B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$			(-)15	V

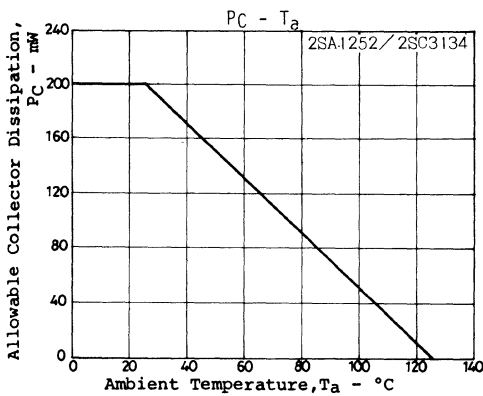
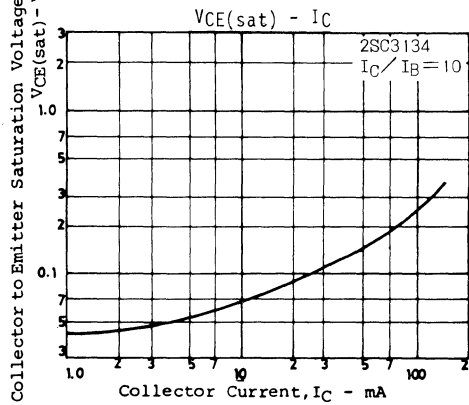
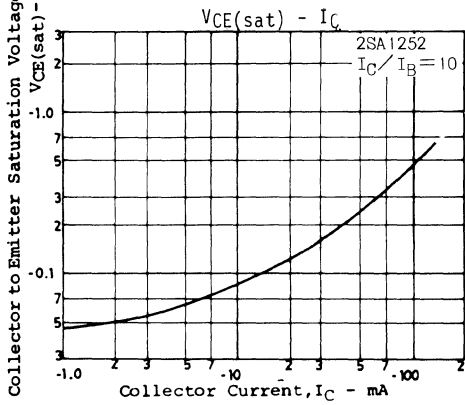
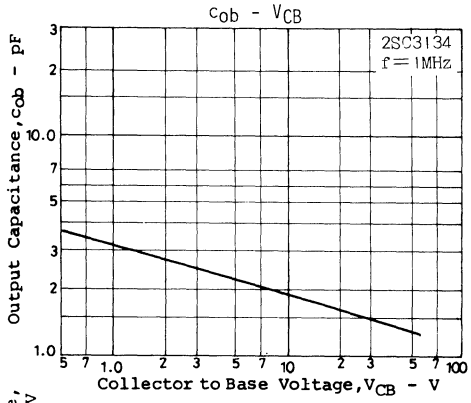
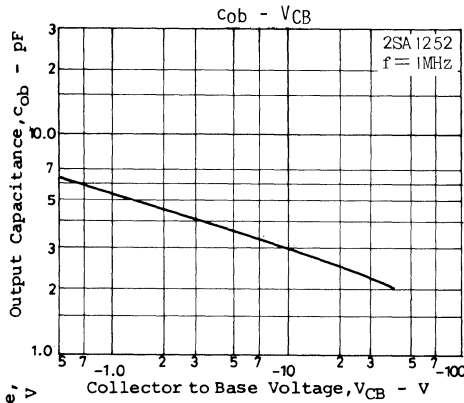
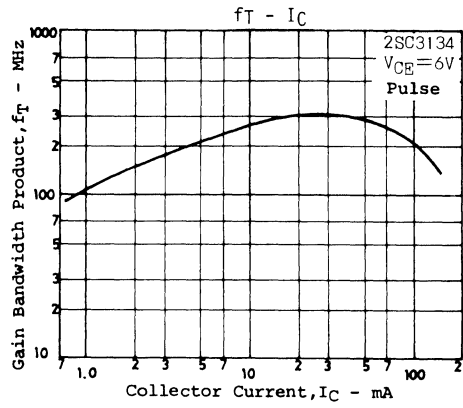
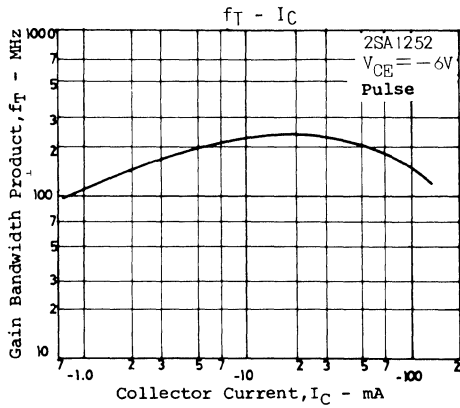
*The 2SA1252/2SC3134 are classified as follows according to h_{FE} at 1mA.

2SA1252	90	D4	180	135	D5	270	200	D6	400	300	D7	600
2SC3134	90	H4	180	135	H5	270	200	H6	400	300	H7	600

Case Outline 2018 (unit:mm)







2SC3135



2000B

NPN/PNP Epitaxial Planar
Silicon Transistors**2SA1253**

Low Frequency, General-Purpose Amp Applications

©1049B

Features

- High V_{EBO}
- Wide ASO and high durability against breakdown

(): 2SA1253

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Collector to base voltage	V_{CBO}	(-)60	V
Collector to emitter voltage	V_{CEO}	(-)50	V
Emitter to base voltage	V_{EBO}	(-)15	V
Collector current	I_C	(-)200	mA
Peak collector current	i_{cp}	(-)400	mA
Collector dissipation	P_C	250	mW
Junction temperature	T_j	150	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ~ +150	$^\circ\text{C}$

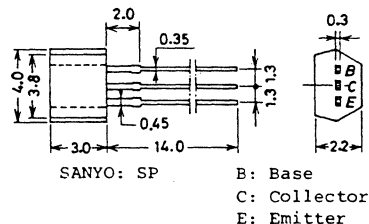
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

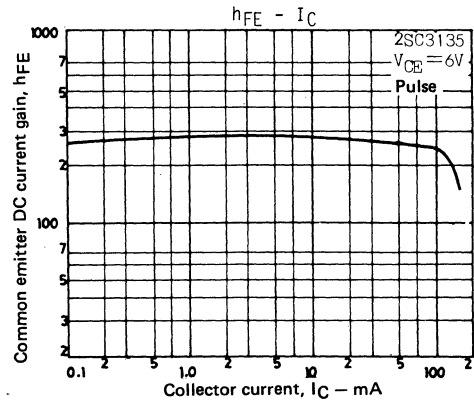
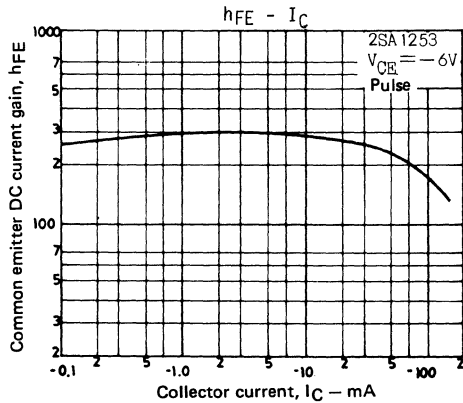
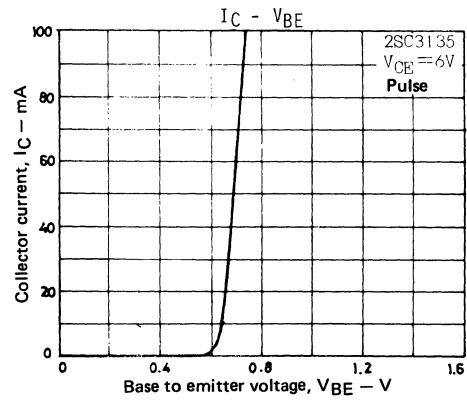
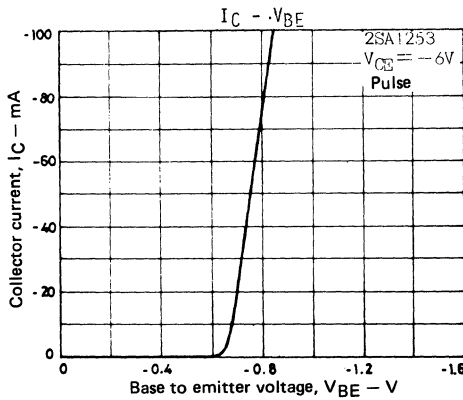
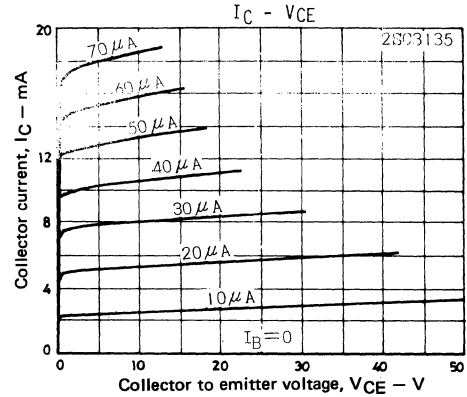
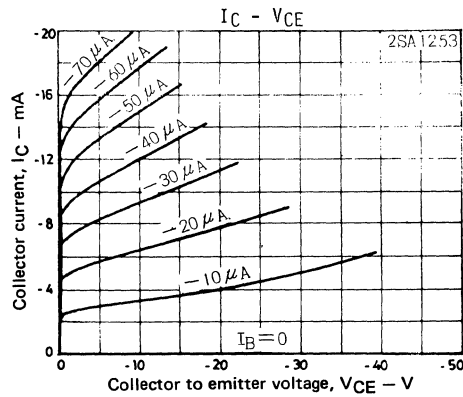
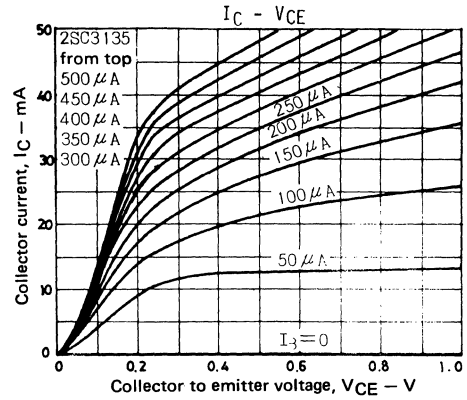
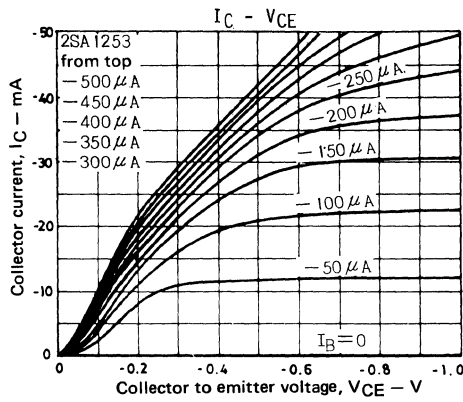
			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = (-)40\text{V}, I_E = 0$			(-)0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = (-)10\text{V}, I_C = 0$			(-)0.1	μA
DC current gain	h_{FE}	$V_{CE} = (-)6\text{V}, I_C = (-)1\text{mA}$	100*		560*	
Gain bandwidth product	f_T	$V_{CE} = (-)6\text{V}, I_C = (-)1\text{mA}$		100		MHz
Common base output capacitance	c_{ob}	$V_{CB} = (-)6\text{V}, f = 1\text{MHz}$		(3.8)		pF
				2.5		
Collector to emitter saturation voltage $V_{CE(sat)}$	$I_C = (-)50\text{mA}, I_B = (-)5\text{mA}$		(-0.2)	(-)0.5		V
				0.15		
Collector to base breakdown voltage $V_{(BR)CBO}$	$I_C = (-)10\mu\text{A}, I_E = 0$		(-)60			V
Collector to emitter breakdown voltage $V_{(BR)CEO}$	$I_C = (-)1\text{mA}, R_{BE} = \infty$		(-)50			V
Emitter to base breakdown voltage $V_{(BR)EBO}$	$I_E = (-)10\mu\text{A}, I_C = 0$		(-)15			V

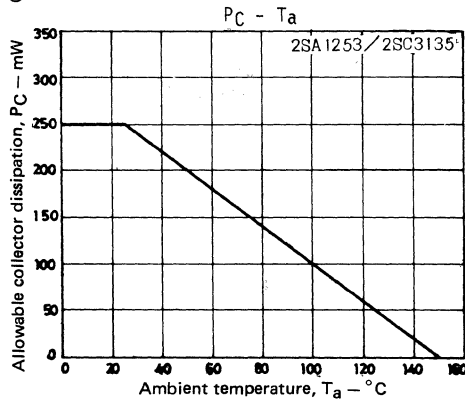
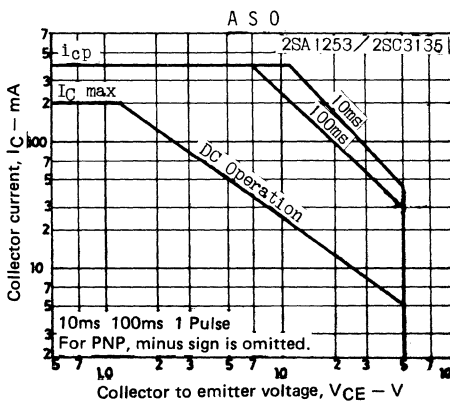
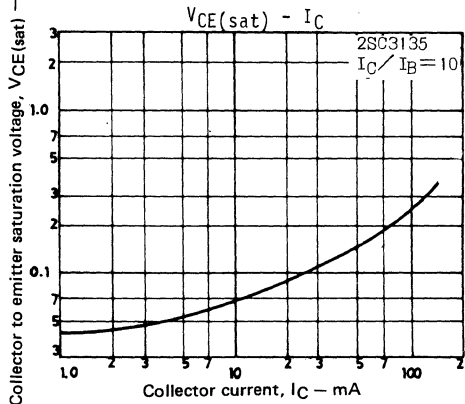
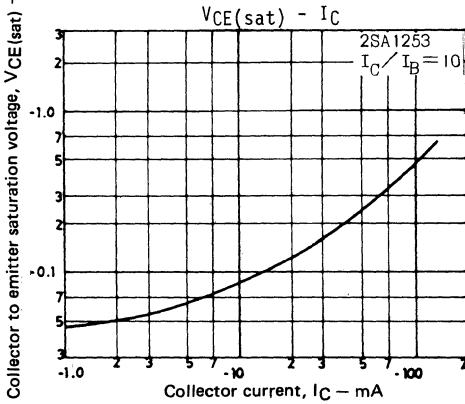
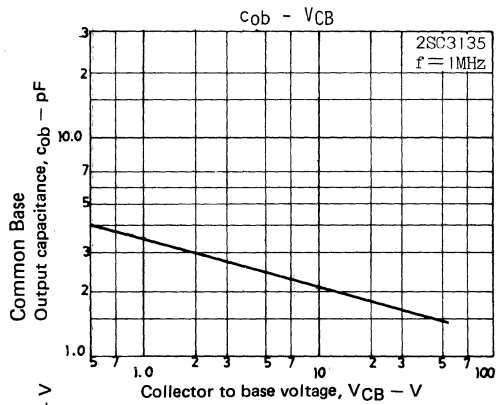
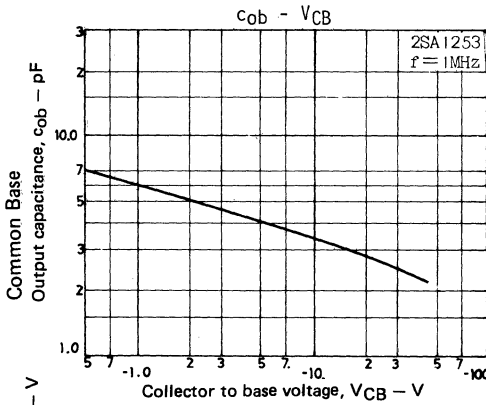
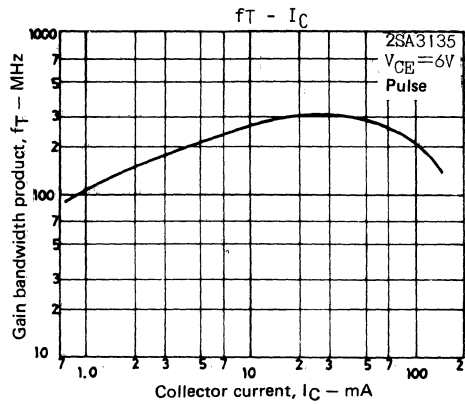
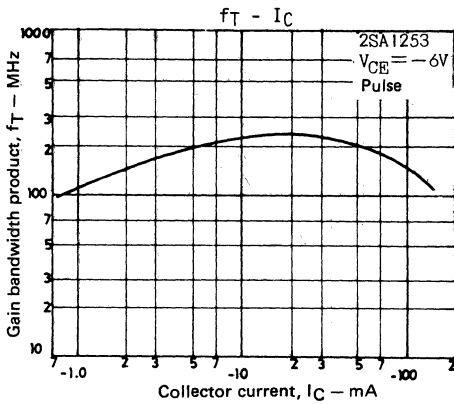
* The 2SA1253/2SC3135 are classified by 1 mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400	280	U	560
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Case Outline 2000B
(unit: mm)







2SC3142

2018

NPN Epitaxial Planar
Silicon Transistor

High Frequency, General-Purpose Amp Applications

©1066

Features

- . FBET series.
- . Compact package enabling compactness of sets.
- . High f_T and small c_{re} . ($f_T=750\text{MHz}$ typ, $c_{re}=0.6$ typ)

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	25	V
Collector to Emitter Voltage	V_{CEO}	20	V
Emitter to Base Voltage	V_{EBO}	3	V
Collector Current	I_C	30	mA
Collector Dissipation	P_C	150	mW
Junction Temperature	T_j	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to +125	$^\circ\text{C}$

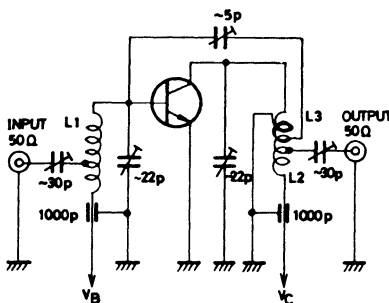
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=10\text{V}, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=3\text{V}, I_C=0$			0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=6\text{V}, I_C=1\text{mA}$	40*		180*	
Gain Bandwidth Product	f_T	$V_{CE}=6\text{V}, I_C=4\text{mA}$	450	750		MHz
Feedback Capacitance	c_{re}	$V_{CB}=6\text{V}, f=1\text{MHz}$		0.6	0.9	pF
B to C Time Constant	$r_{bb}'C_C$	$V_{CB}=6\text{V}, I_C=1\text{mA}, f=31.9\text{MHz}$			19	ps
Noise Figure	NF	$V_{CE}=6\text{V}, I_C=1\text{mA}, f=100\text{MHz}$		2.2		dB
Power Gain	PG	$V_{CE}=6\text{V}, I_C=1\text{mA}, f=100\text{MHz}$		28		dB

* The 2SC3142 is classified as follows according to h_{FE} at 1mA.

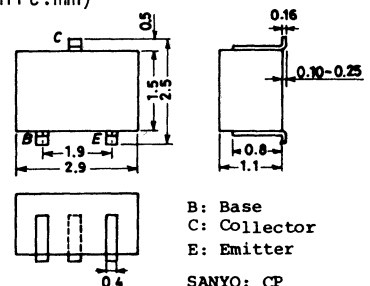
40	J2	80	60	J3	120	90	J4	180
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NG, PG Test Circuit

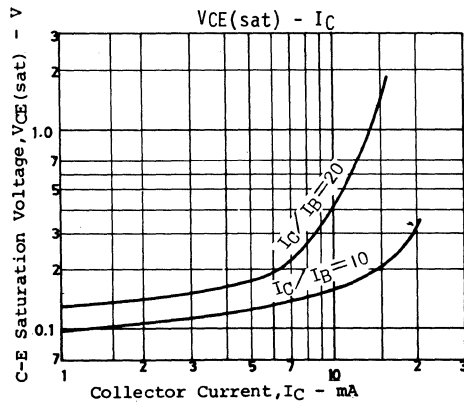
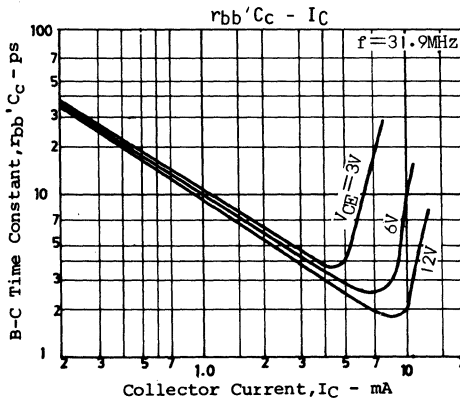
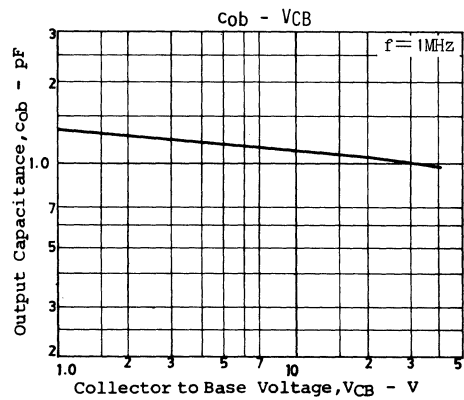
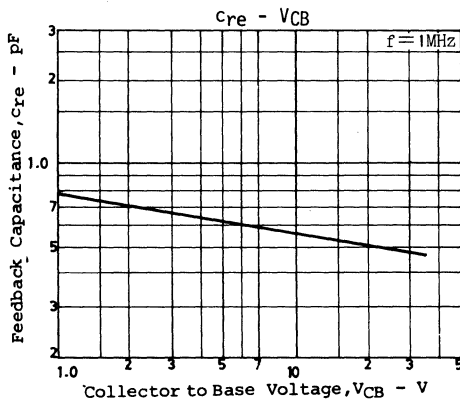
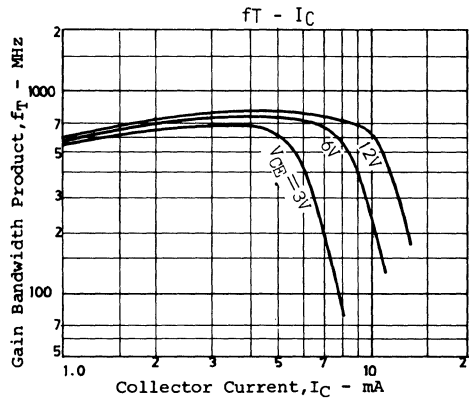
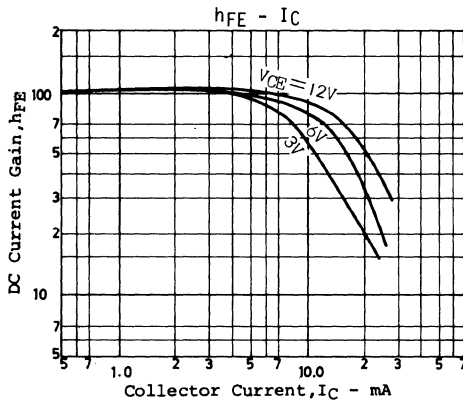
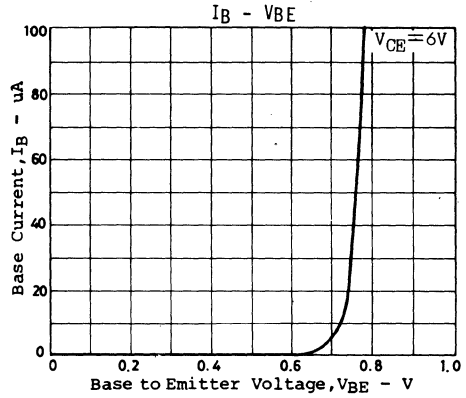
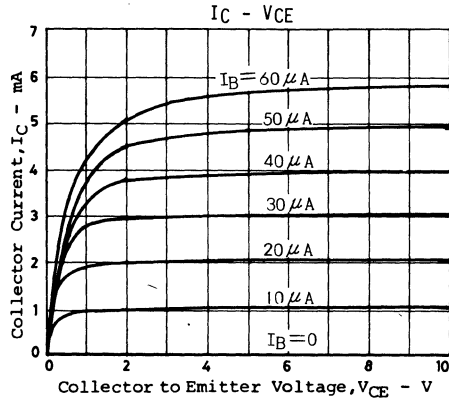


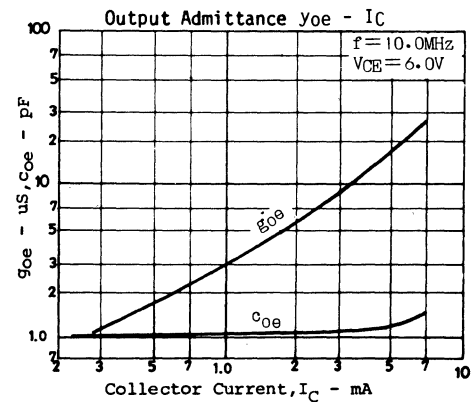
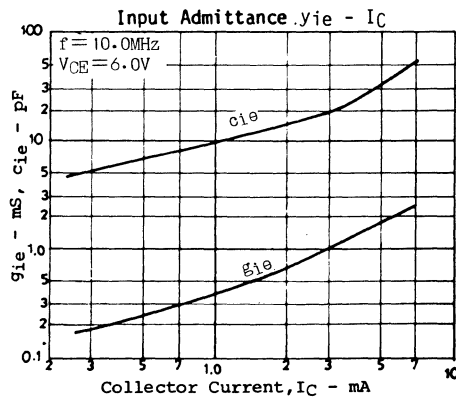
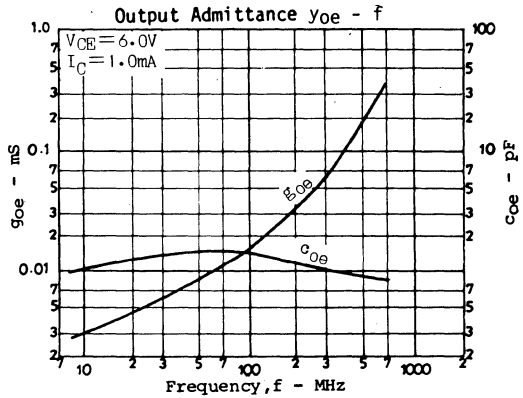
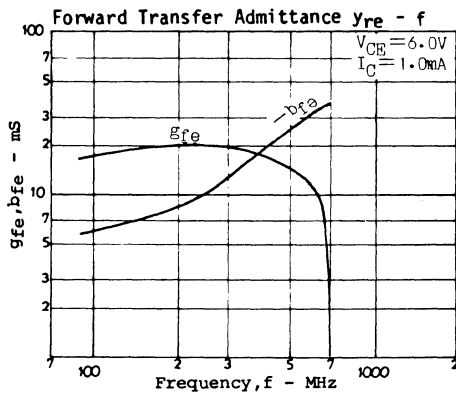
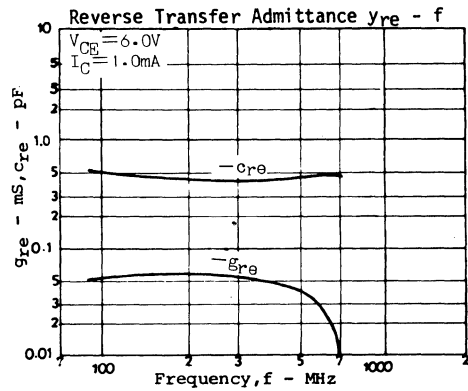
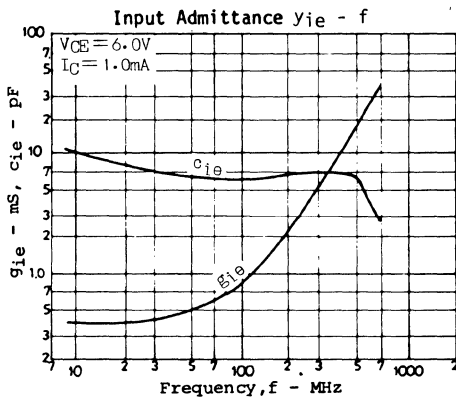
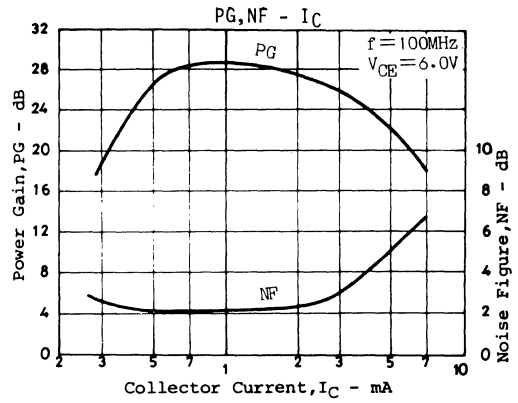
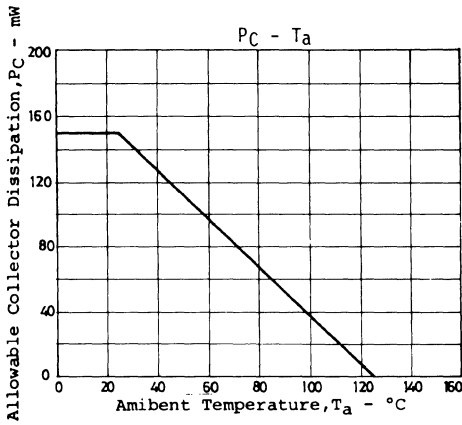
- L1: 1mm ϕ plated wire 10mm ϕ 5T, pitch 15mm, tap: 2T from base.
L2: 1mm ϕ plated wire 10mm ϕ 7T, pitch 10mm, tap: 2T from V_C .
L3: 1mm ϕ enameled wire 10mm ϕ 3T, pitch 10mm.

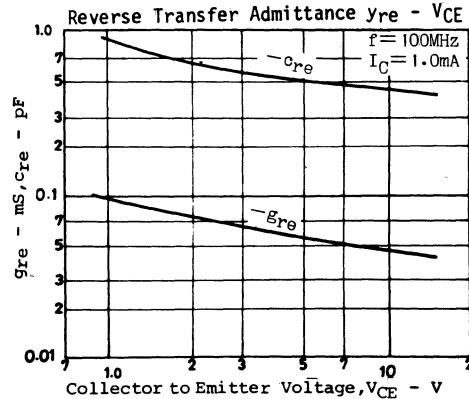
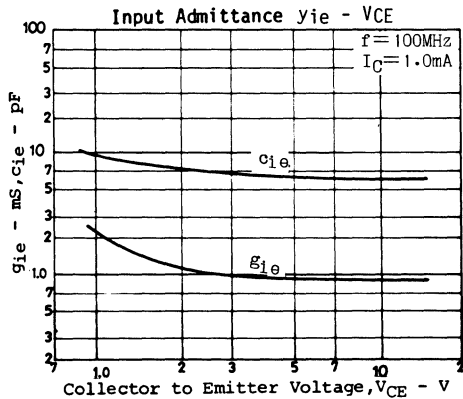
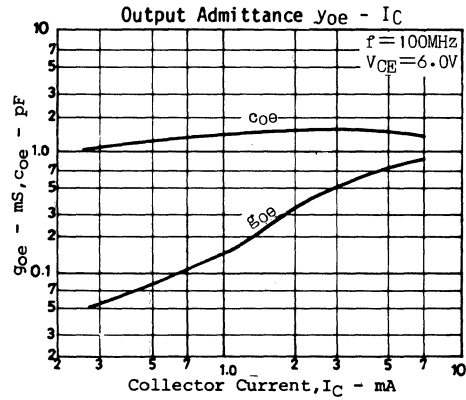
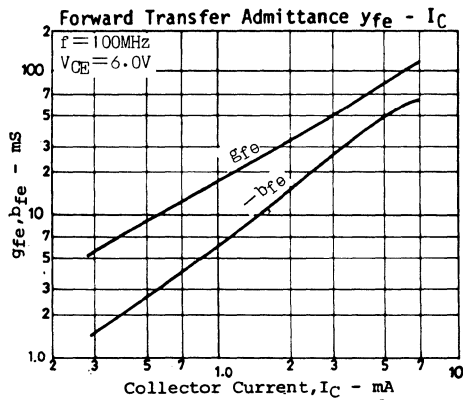
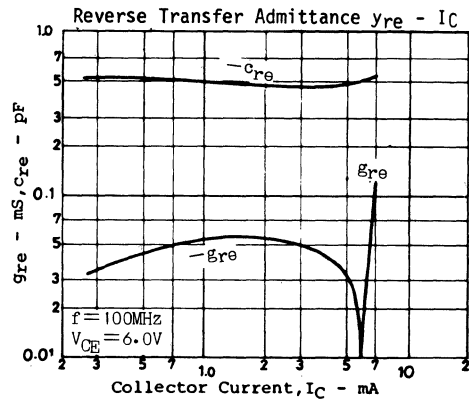
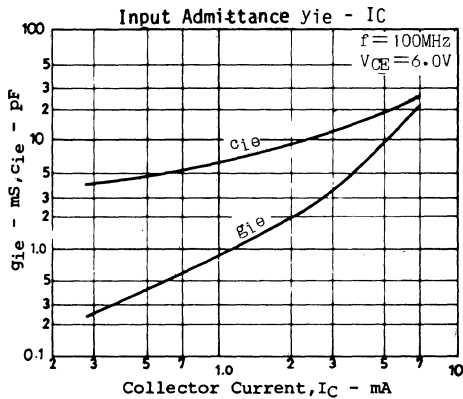
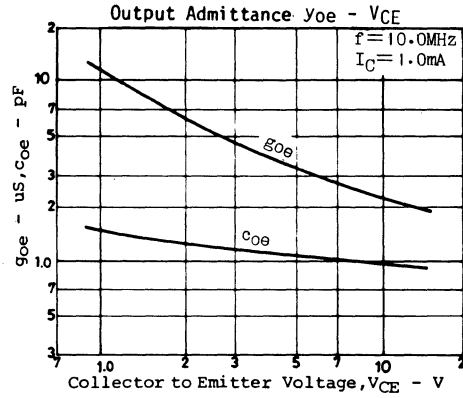
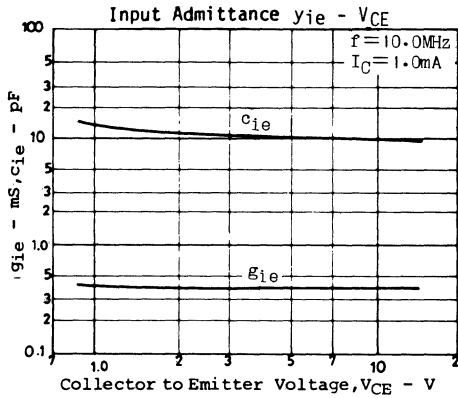
Case Outline 2018 (unit:mm)

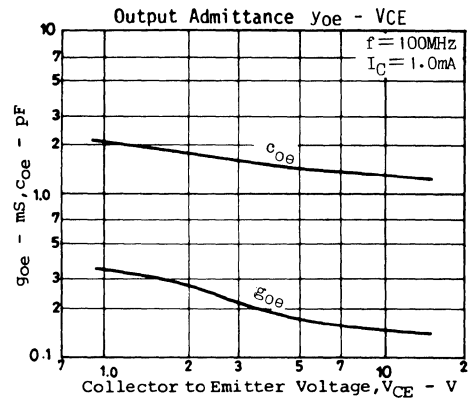
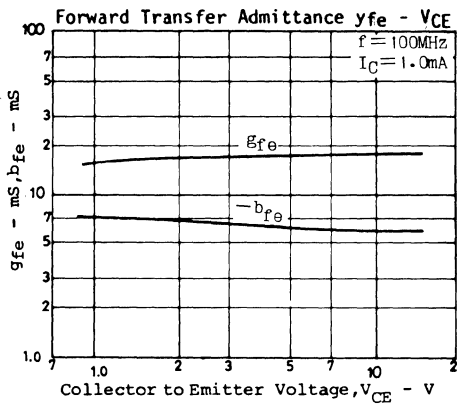


B: Base
C: Collector
E: Emitter
SANYO: CP









2SC3143

2018

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1257

High Voltage Switching, AF 100W Predriver Applications

©1057

Features:

- Very small package enabling compactness and slimness of sets
- High breakdown voltage ($V_{CE0} \geq 160V$)
- Small output capacitance

(): 2SA1257

Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	(-)180	V
Collector to Emitter Voltage	V_{CEO}	(-)160	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)80	mA
Peak Collector Current	i_{co}	(-)150	mA
Collector Dissipation	PC	200	mW
Junction Temperature	T_j	125	$^\circ C$
Storage Temperature	T_{stg}	-55 to +125	$^\circ C$

Electrical Characteristics at $T_a = 25^\circ C$

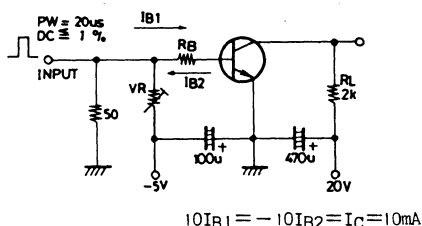
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-)120V, I_E = 0$		(-)0.1		μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$		(-)0.1		μA
DC Current Gain	h_{FE}	$V_{CE} = (-)5V, I_C = (-)10mA$	60*		270*	
Gain Bandwidth Product	f_T	$V_{CE} = (-)10V, I_C = (-)10mA$		(130)		MHz
				150		
Output Capacitance	c_{ob}	$V_{CB} = (-)10V, f = 1MHz$		(2.4)	(3.2)	pF
				2.0	2.8	
Base to Emitter Voltage	V_{BE}	$V_{CE} = (-)5V, I_C = (-)10mA$		(-)1.5		V
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-)30mA, I_B = (-)3mA$		(-)0.7		V
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C = (-)10\mu A, I_E = 0$	(-)180			V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-)160			V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E = (-)10\mu A, I_C = 0$	(-)5			V
Rise Time	t_{on}	[at specified test circuit]		(0.15)	0.18	μs
Storage Time	t_{stg}			(0.95)	1.00	μs
Fall Time	t_f			(0.15)	0.20	μs

*: The 2SA1257/2SC3143 are classified by 10mA h_{FE} as follows.

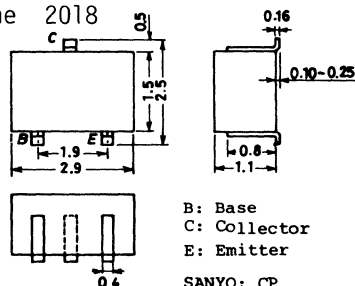
2SA1257	60	G3	120	90	G4	180	135	G5	270
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2SC3143	60	K3	120	90	K4	180	135	K5	270
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Switching Time Test Circuit

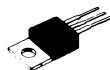


Case Outline 2018 (unit:mm)



D103KI, MT No.10571/1

2SC3144



2010A

NPN/PNP Epitaxial Planar
Silicon Darlington Transistors

2SA1258

High Speed Driver Applications

©1058A

Features

- High f_T
- High switching speed
- Wide ASO

(): 2SA1258

Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)70	V
Collector to Emitter Voltage	V_{CEO}	(-)60	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)3	A
Peak Collector Current	i_{cp}	(-)5	A
Collector Dissipation	P_C	1.75	W
		$T_C=25^\circ\text{C}$	
		20	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

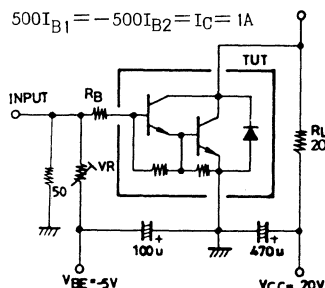
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$			(-)3	mA
Common Emitter DC Current Gain	h_{FE}	$V_{CE}=(-)2\text{V}, I_C=(-)1.5\text{A}$	2000	5000		
Gain Band-width Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1.5\text{A}$		200		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)1.5\text{A}, I_B=(-)3\text{mA}$		(-1.0)	(-1.5)	V
				0.9		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)1.5\text{A}, I_B=(-)3\text{mA}$			(-)2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)70			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)60			V
Turn-on Time	t_{on}	at Specified Test Circuit		0.3		μs
Storage Time	t_{stg}	"		(1.3)		μs
				1.2		
Fall Time	t_f	"		0.2		μs

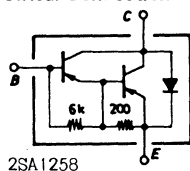
Specified Test Circuit
(For PNP, the polarity is reversed.)

$PW=50\mu\text{s}, \text{Duty Cycle} \leq 1\%$

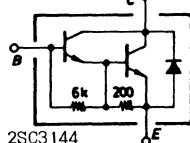
$500I_{B1} = -500I_{B2} = I_C = 1\text{A}$



Electrical Connection

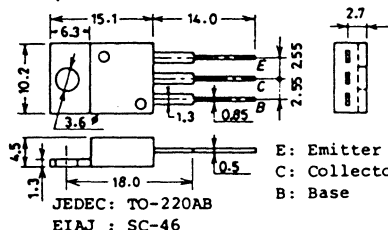


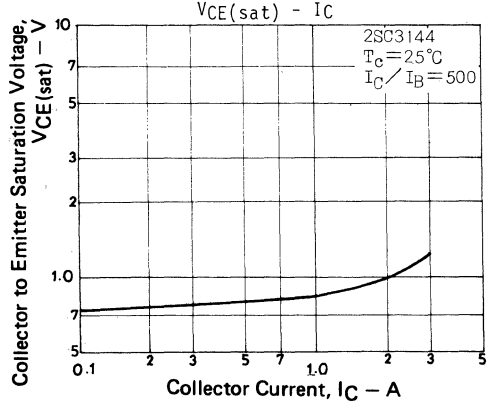
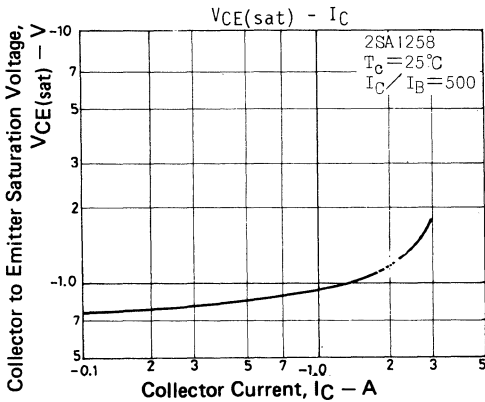
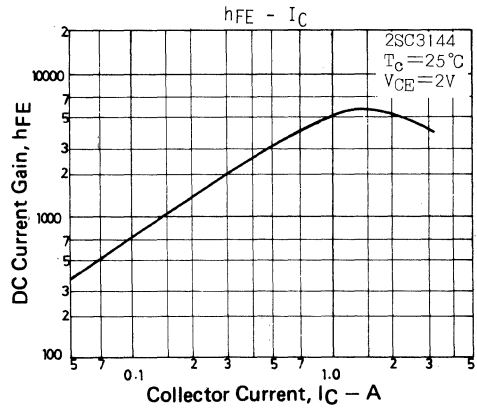
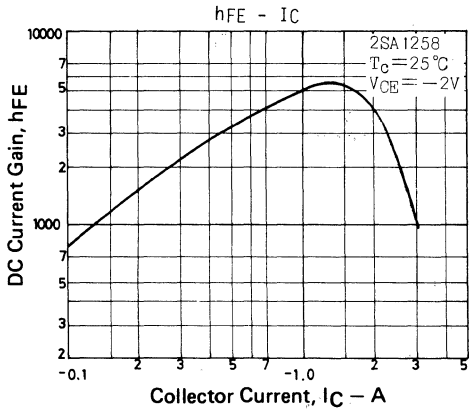
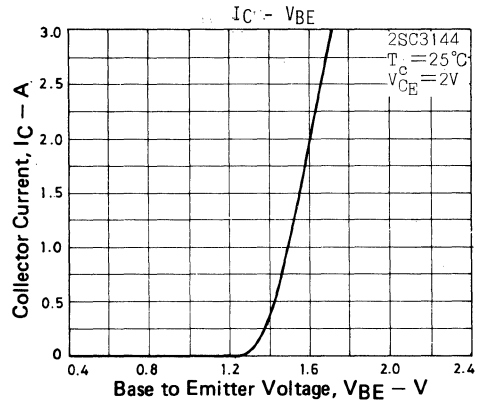
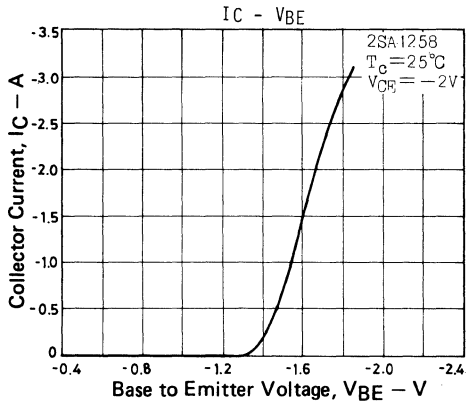
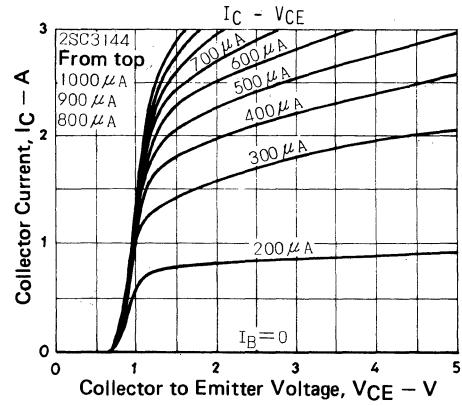
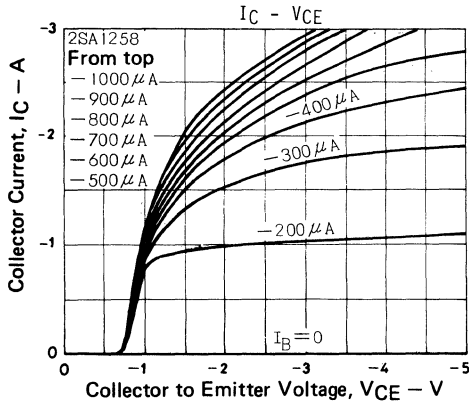
2SA1258

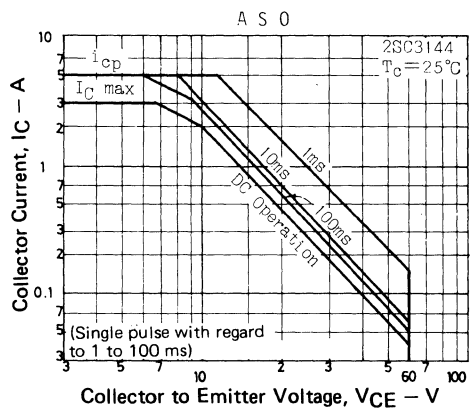
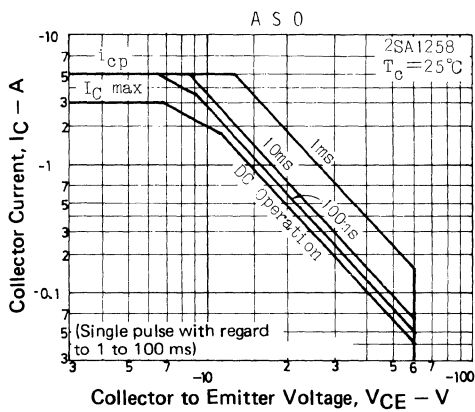
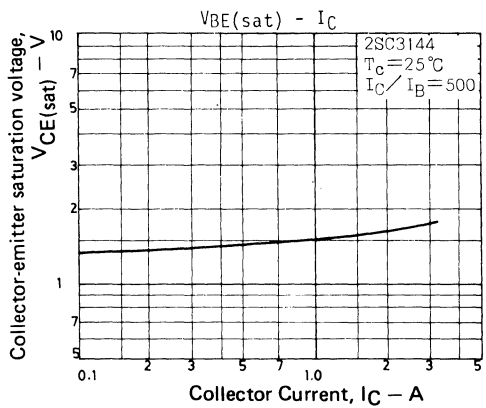
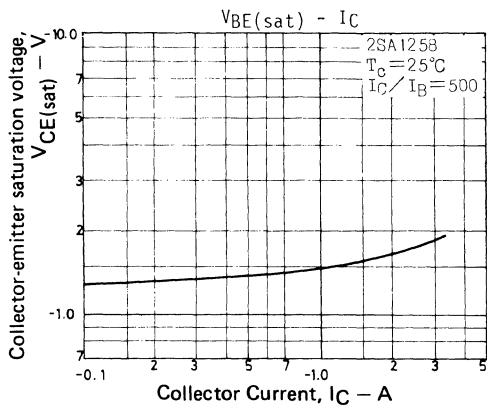


2SC3144

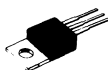
Case Outline 2010A (unit: mm)







2SC3145



2010A

NPN/PNP Epitaxial Planar
Silicon Darlington Transistors

2SA1259

High Speed Driver Applications

©1059A

Features

- High f_T
- High switching speed
- Wide ASO

(): 2SA1259

Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

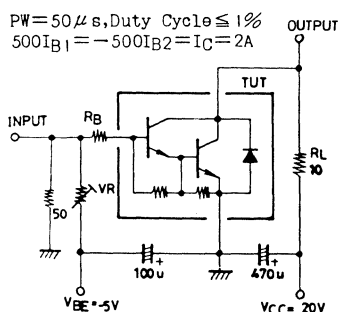
		unit
Collector to Base Voltage	V_{CBO}	(-)70 V
Collector to Emitter Voltage	V_{CEO}	(-)60 V
Emitter to Base Voltage	V_{EBO}	(-)5 V
Collector Current	I_C	(-)5 A
Peak Collector Current	i_{cp}	(-)8 A
Collector Dissipation	P_C	1.75 W
	$T_C=25^\circ\text{C}$	30 W
Junction Temperature	T_j	150 $^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150 $^\circ\text{C}$

Electrical Characteristics/ $T_a=25^\circ\text{C}$

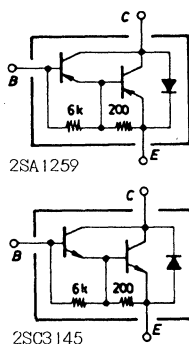
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$			(-)3	mA
Common Emitter DC Current Gain	h_{FE}	$V_{CE}=(-)2\text{V}, I_C=(-)2.5\text{A}$	2000	5000		
Gain Band-width Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)2.5\text{A}$		200		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)2.5\text{A}, I_B=(-)5\text{mA}$		(-)1.0	(-)1.5	V
				0.9		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)2.5\text{A}, I_B=(-)5\text{mA}$			(-)2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)70			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)60			V

Specified Test Circuit

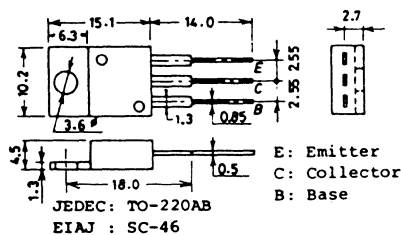
(For PNP, the polarity is reversed.)



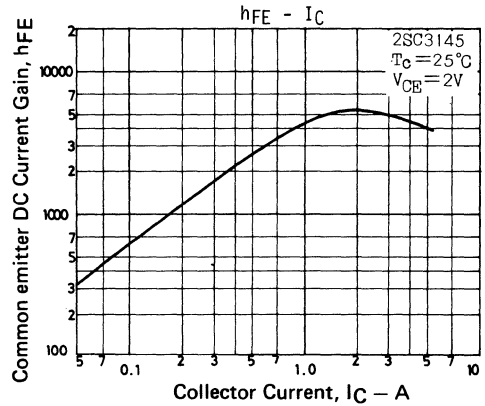
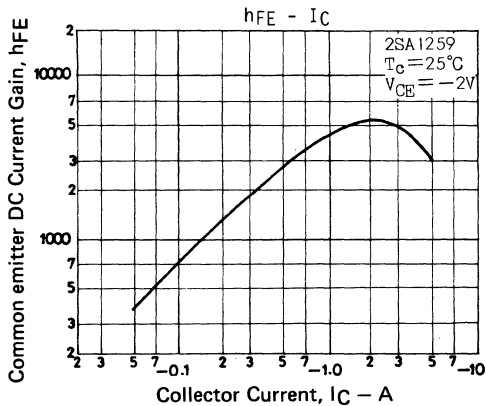
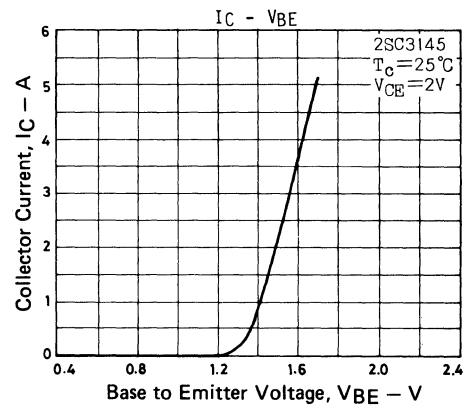
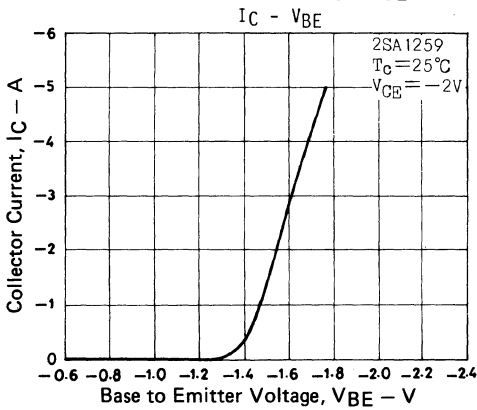
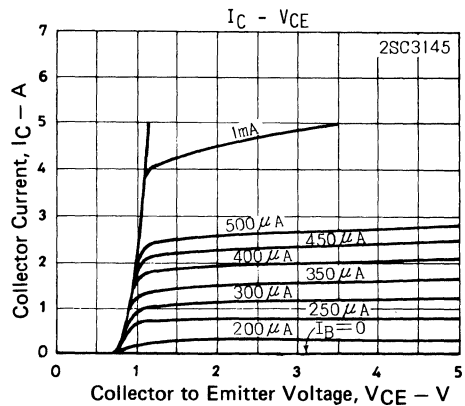
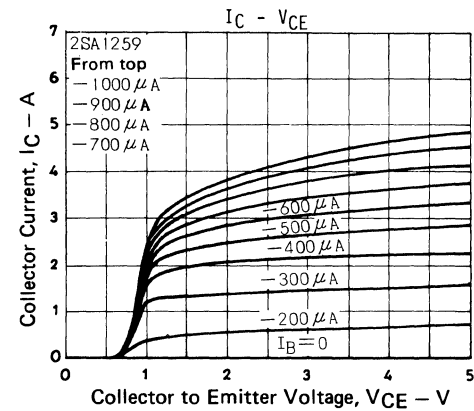
Electrical Connection

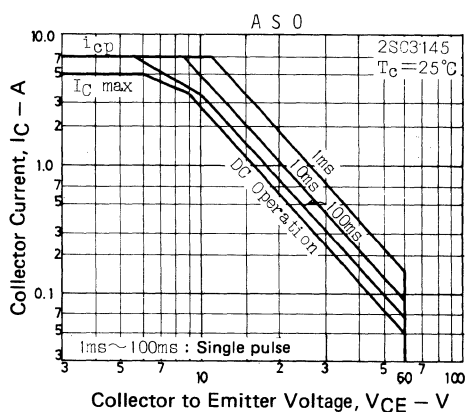
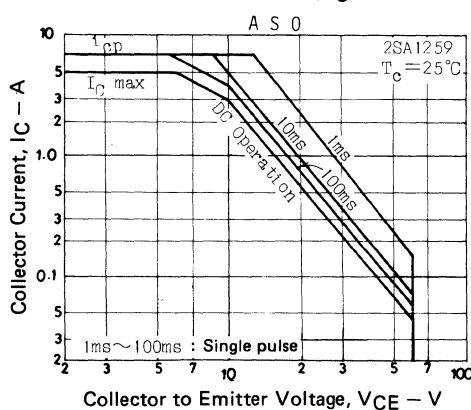
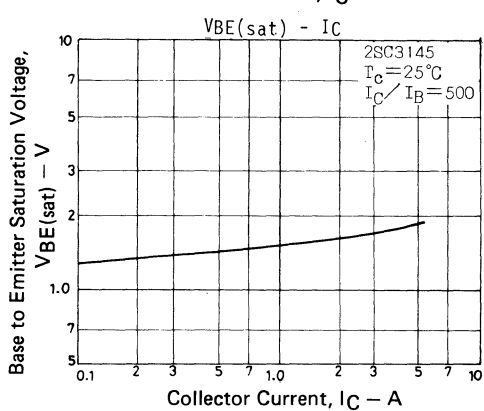
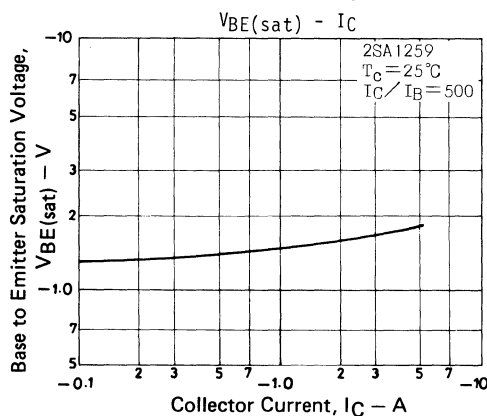
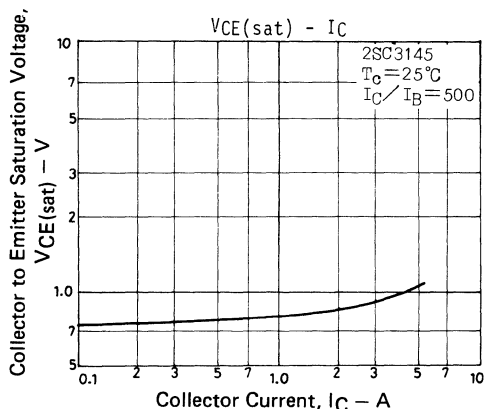
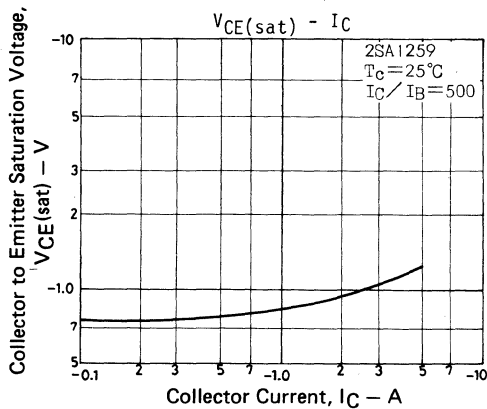


Case Outline 2010A (unit; mm)

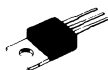


Turn-ON Time	T_{on}	at Specified Test Circuit	min	typ	max	unit
Storage Time	t_{stg}	at Specified Test Circuit		0.3		μs
				(1.3)		μs
				1.2		
Fall Time	t_f	at Specified Test Circuit		0.2		μs





2SC3149



2010A

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1068B

Features

- High breakdown voltage($V_{CB0} \geq 900V$).
- Fast switching speed.
- Wide ASO.

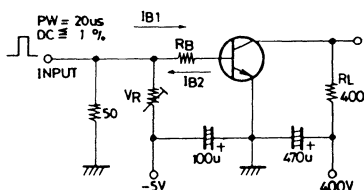
Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CB0}	900	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Current	V_{EBO}	7	V
Collector Current	I_C	1.5	A
Peak Collector Current	i_{cp}	5	A
		Pulse, $PW \leq 300\mu s$, Duty Cycle $\leq 10\%$	
Base Current	I_B	0.8	A
Collector Dissipation	P_C	40	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

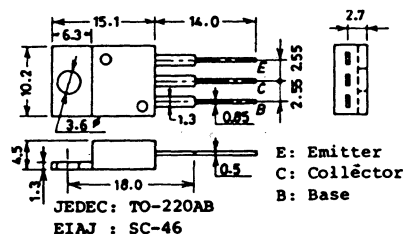
Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = 800V, I_E = 0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 5V, I_C = 0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = 5V, I_C = 0.1A$	10			
	$h_{FE}(2)$	$V_{CE} = 5V, I_C = 0.5A$	8			
Gain Bandwidth Product	f_T	$V_{CE} = 10V, I_C = 0.1A$		15		MHz
Output Capacitance	c_{ob}	$V_{CB} = 10V, f = 1MHz$		30		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = 0.75A, I_B = 0.15A$			2.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = 0.75A, I_B = 0.15A$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CB0}$	$I_C = 1mA, I_E = 0$			900	V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 5mA, R_{BE} = \infty$			800	V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 1mA, I_C = 0$			7	V
C-E Sustain Voltage	$V_{CEO(sus)}$	$I_C = 1.5A, L = 1mH, I_B = 0.5A$			800	V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 0.5A, I_{B1} = 0.1A$			800	V
	(1)	$I_{B2} = -0.1A, L = 5mH, \text{clamped}$				
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C = 0.25A, I_{B1} = 0.05A$			900	V
	(2)	$I_{B2} = -0.05A, L = 10mH, \text{clamped}$				

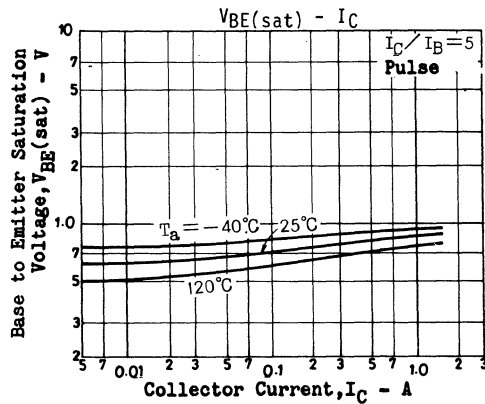
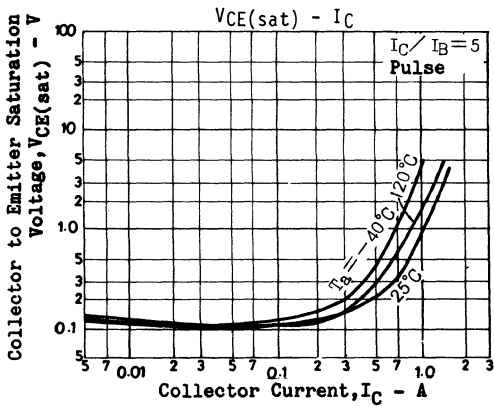
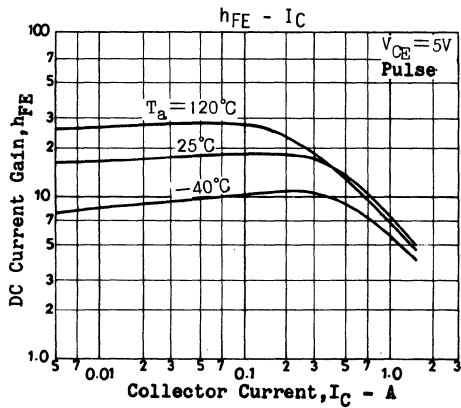
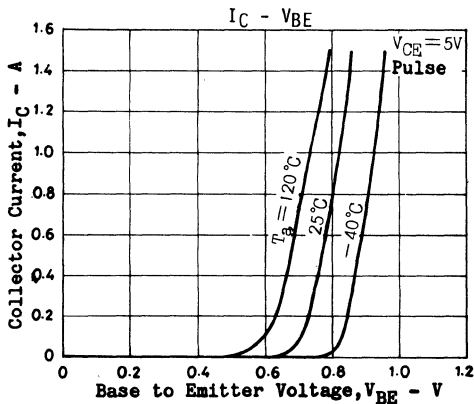
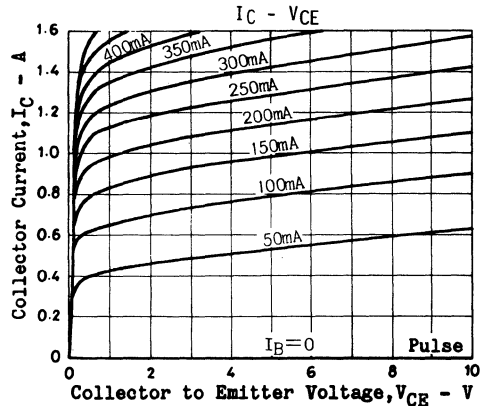
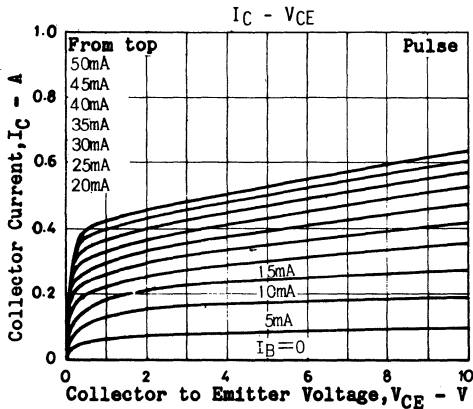
Switching Time Test Circuit

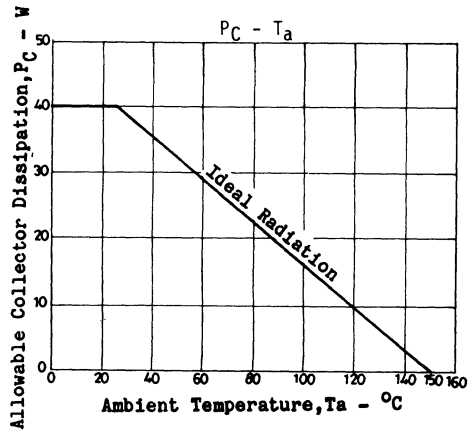
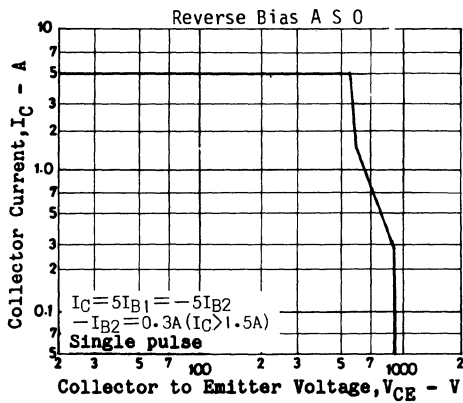
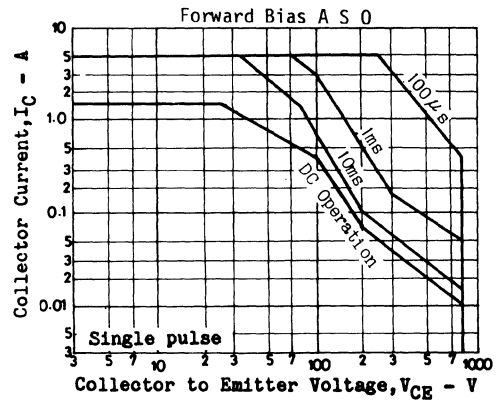
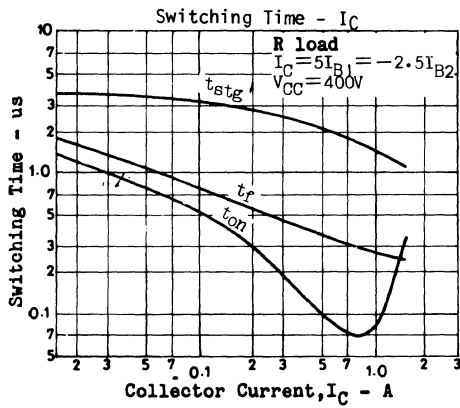


Case Outline 2010A (unit:mm)

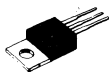


			min	typ	max	unit
Turn-ON Time	t_{on}	$(I_C=1A, I_{B1}=0.2A, I_{B2}=-0.4A,$ $R_L=400\Omega, V_{CC}=400V$			1.0	us
Storage Time	t_{stg}	"			3.0	us
Fall Time	t_f	"			0.7	us





2SC3150



2010A

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1069B

Features

- High reverse voltage ($V_{CBO} \geq 900V$).
- High speed switching.
- Wide ASO.

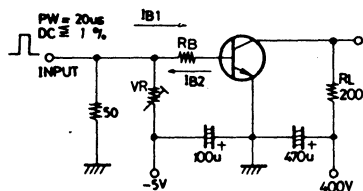
Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	900	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_C	3	A
Peak Collector Current	i_{cp}	Pulse, $PW \leq 300\mu s$, Duty Cycle $\leq 10\%$	10 A
Base Current	I_B	1.5	A
Collector Dissipation	P_C	$T_c=25^\circ C$	50 W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

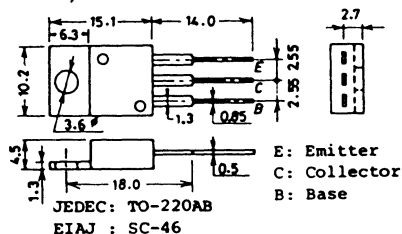
Electrical Characteristics at $T_a=25^\circ C$

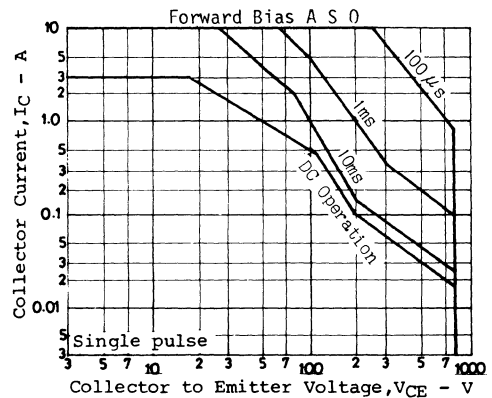
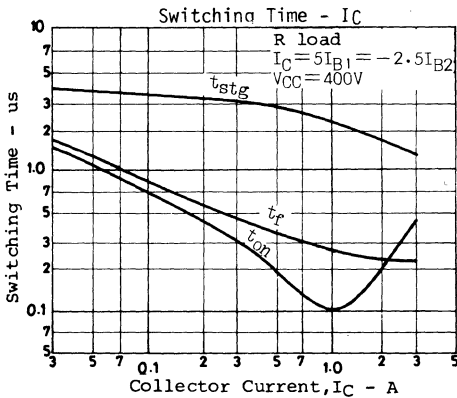
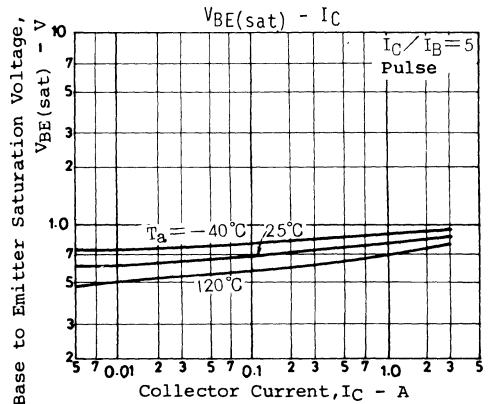
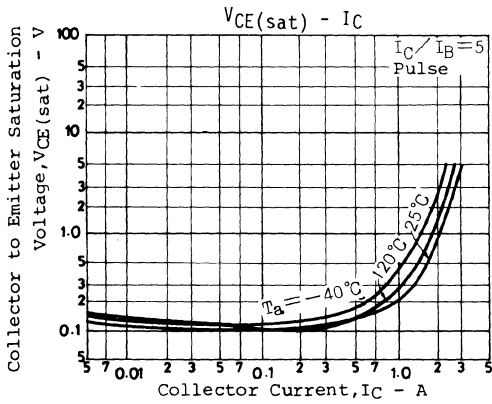
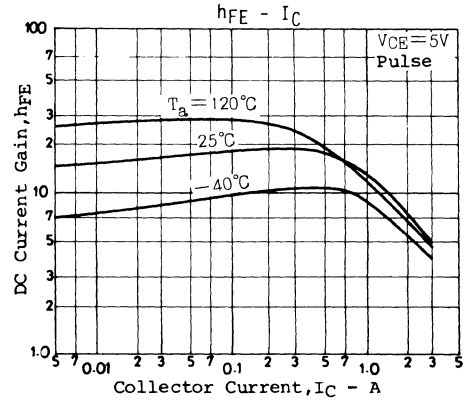
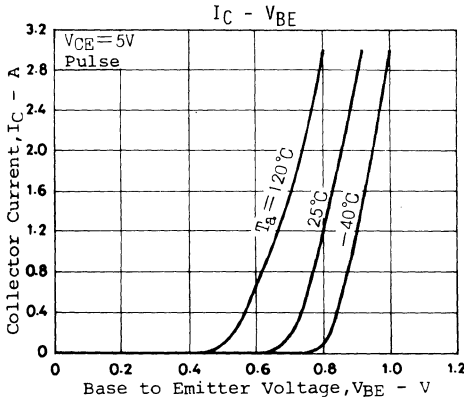
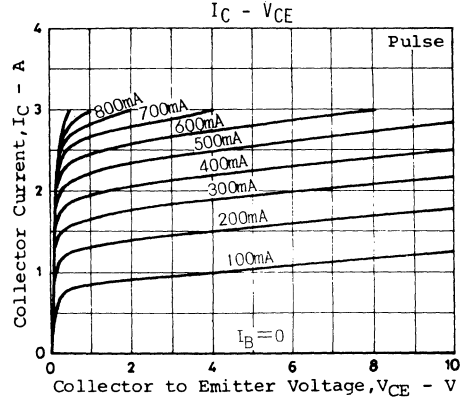
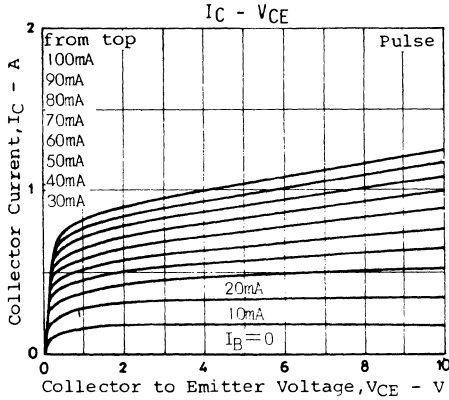
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5V, I_C=0.2A$	10			
	$h_{FE}(2)$	$V_{CE}=5V, I_C=1A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.2A$		15		MHz
Output Capacitance	c_{ob}	$V_{CB}=10V, f=1MHz$		60		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=1.5A, I_B=0.3A$			2.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=1.5A, I_B=0.3A$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1mA, I_E=0$	900			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=5mA, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1mA, I_C=0$	7			V
C-E Sustain Voltage	$V_{CEO(sus)}$	$I_C=3A, L=500\mu H, I_B=1A$	800			V
	$V_{CEX(sus)}(1)$	$I_C=1A, I_{B1}=0.2A, I_{B2}=-0.2A, L=2mH, \text{Clamped}$	800			V
	$V_{CEX(sus)}(2)$	$I_C=0.5A, I_{B1}=0.1A, I_{B2}=-0.1A, L=5mH, \text{Clamped}$	900			V
Turn-On Time	t_{on}				1.0	μs
Storage Time	t_{stg}	$I_C=2A, I_{B1}=0.4A, I_{B2}=-0.8A, R_L=200\Omega, V_{CC}=400V$			3.0	μs
Fall Time	t_f				0.7	μs

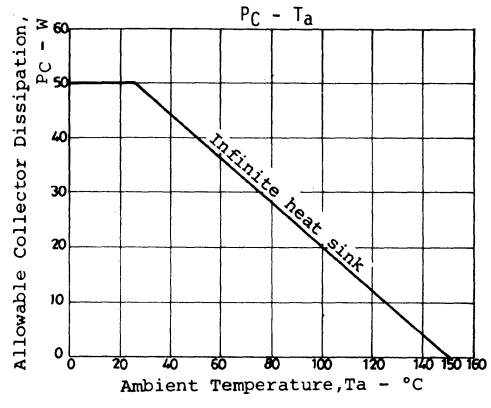
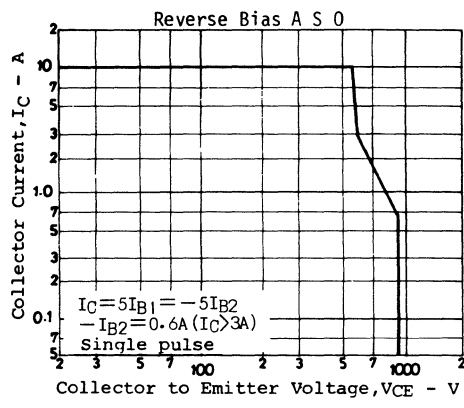
Switching Time Test Circuit



Case Outline 2010A (unit:mm)







2SC3151



2022

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1070B

Features

- High breakdown voltage ($V_{CBO} \geq 900V$)
- High switching speed
- Wide ASO

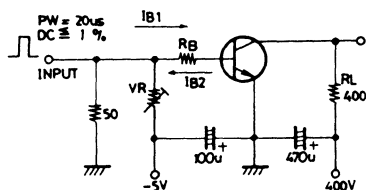
Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	900	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_C	1.5	A
Peak Collector Current	i_{cp}	5	A
		Pulse, $PW \leq 300\mu s$, Duty Cycle $\leq 10\%$	
Base Current	I_B	0.8	A
Collector Dissipation	P_C	60	W
		$T_C = 25^\circ C$	
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

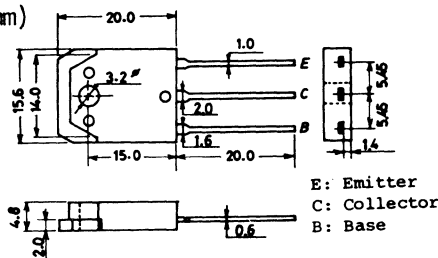
Electrical Characteristics at $T_a = 25^\circ C$

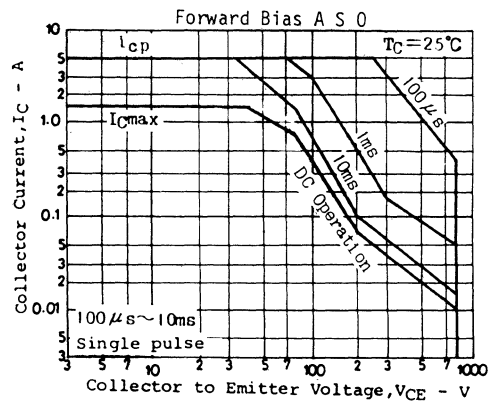
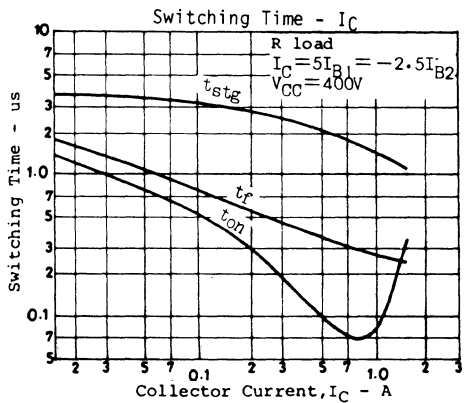
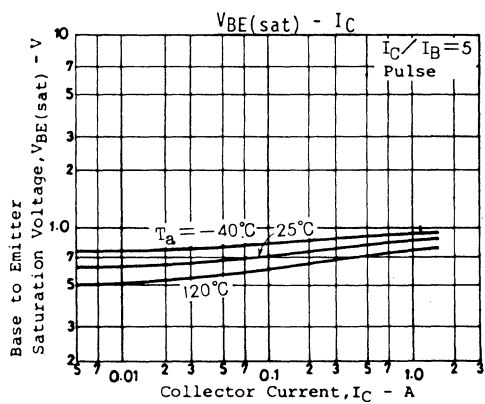
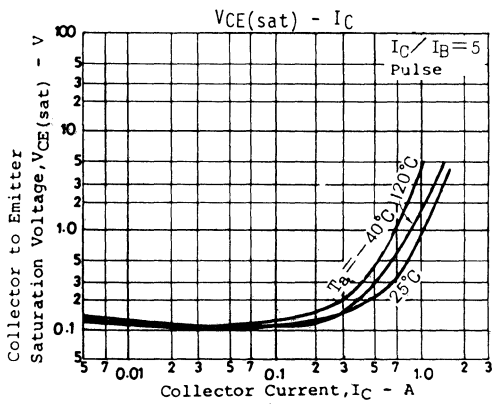
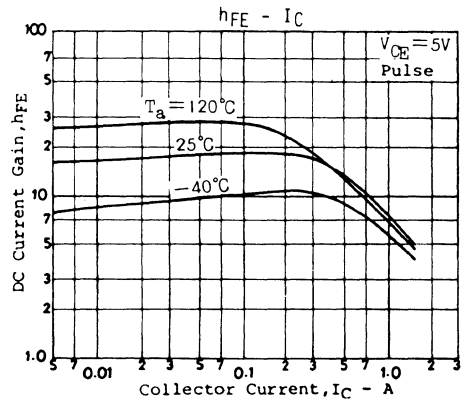
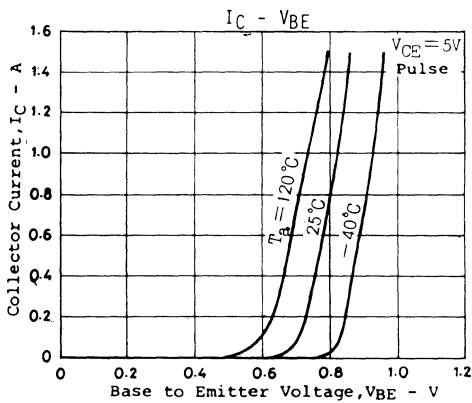
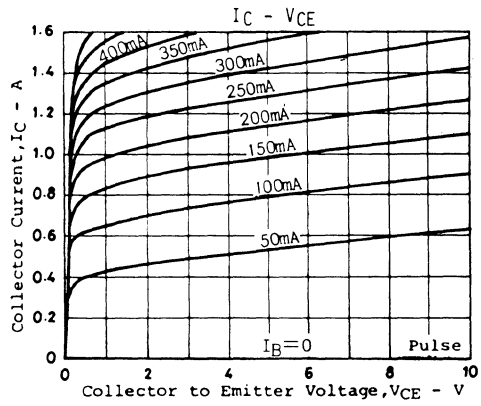
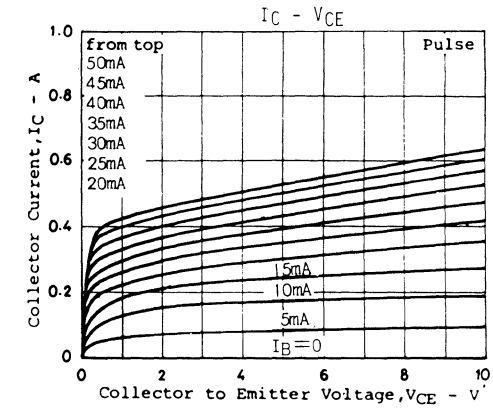
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = 800V, I_E = 0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 5V, I_C = 0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = 5V, I_C = 0.1A$	10			
	$h_{FE}(2)$	$V_{CE} = 5V, I_C = 0.5A$	8			
Gain Band-width Product	f_T	$V_{CE} = 10V, I_C = 0.1A$		15		MHz
Output Capacitance	C_{ob}	$V_{CB} = 10V, f = 1MHz$		30		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = 0.75A, I_B = 0.15A$			2.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = 0.75A, I_B = 0.15A$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 1mA, I_E = 0$	900			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 5mA, R_{BE} = \infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 1mA, I_C = 0$	7			V
C-E Sustain Voltage	$V_{CEO(sus)}$	$I_C = 1.5A, L = 1mH, I_B = 0.5A$	800			V
"	$V_{CEX(sus)}$	$I_C = 0.5A, I_{B1} = 0.1A, I_{B2} = -0.1A, L = 5mH, \text{Clamped}$	800			V
"	$V_{CEX(sus)}$	$I_C = 0.25A, I_{B1} = 0.05A, I_{B2} = -0.05A, L = 10mH, \text{Clamped}$	900			V
Turn-on Time	t_{on}	$I_C = 1A, I_{B1} = 0.2A, I_{B2} = -0.4A, R_L = 400\Omega, V_{CC} = 400V$			1.0	μs
Storage Time	t_{stg}	"			3.0	μs
Fall Time	t_f	"			0.7	μs

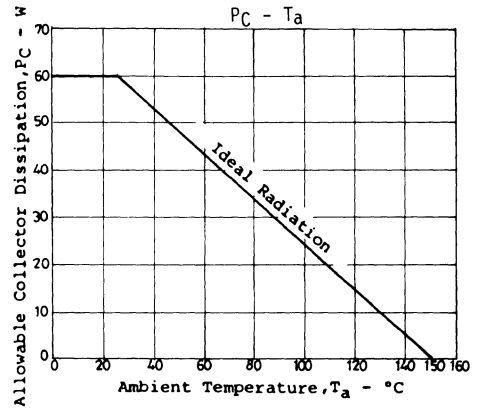
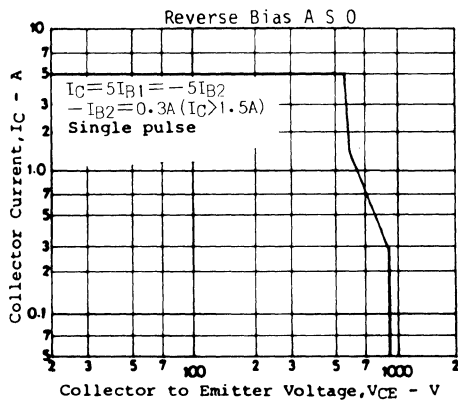
Switching Time Test Circuit



Case Outline 2022 (unit:mm)









NPN Triple Diffused Planar Silicon Transistor

2022

Switching Regulator Applications

©1071B

Features

- . High breakdown voltage ($V_{CBO} \geq 900V$)
- . High switching speed
- . Wide ASO

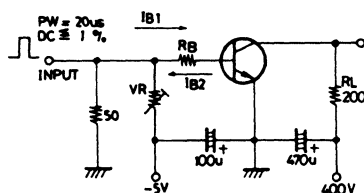
Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

Solute Maximum Ratings at T _a =25°C			unit
Collector to Base Voltage	V _{CBO}	900	V
Collector to Emitter Voltage	V _{CEO}	800	V
Emitter to Base Voltage	V _{EBO}	7	V
Collector Current	I _C	3	A
Peak Collector Current	i _{cp}	10	A
	Pulse, PW≤300us, Duty Cycle≤10%		
Base Current	I _B	1.5	A
Collector Dissipation	P _C	80	W
Junction Temperature	T _j	150	°C
Storage Temperature	T _{stg}	-55 to +150	°C

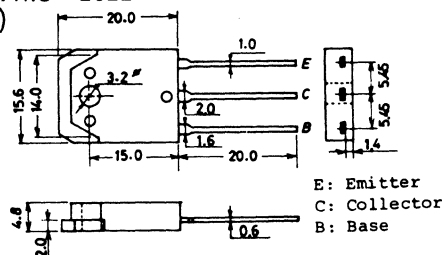
Electrical Characteristics at $T_a=25^\circ\text{C}$

Electrical Characteristics at $T_A=25^{\circ}\text{C}$			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{\text{CB}}=800\text{V}, I_{\text{E}}=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{\text{EB}}=5\text{V}, I_{\text{C}}=0$			10	μA
DC Current Gain	$h_{\text{FE}}(1)$	$V_{\text{CE}}=5\text{V}, I_{\text{C}}=0.2\text{A}$	10			
	$h_{\text{FE}}(2)$	$V_{\text{CE}}=5\text{V}, I_{\text{C}}=1\text{A}$	8			
Gain Band-width Product	f_{T}	$V_{\text{CE}}=10\text{V}, I_{\text{C}}=0.2\text{A}$		15		MHz
Output Capacitance	C_{ob}	$V_{\text{CB}}=10\text{V}, f=1\text{MHz}$		60		pF
C-E Saturation Voltage	$V_{\text{CE}}(\text{sat})$	$I_{\text{C}}=1.5\text{A}, I_{\text{B}}=0.3\text{A}$			2.0	V
B-E Saturation Voltage	$V_{\text{BE}}(\text{sat})$	$I_{\text{C}}=1.5\text{A}, I_{\text{B}}=0.3\text{A}$			1.5	V
C-B Breakdown Voltage	$V(\text{BR})_{\text{CBO}}$	$I_{\text{C}}=1\text{mA}, I_{\text{E}}=0$	900			V
C-E Breakdown Voltage	$V(\text{BR})_{\text{CEO}}$	$I_{\text{C}}=5\text{mA}, R_{\text{BE}}=\infty$	800			V
E-B Breakdown Voltage	$V(\text{BR})_{\text{EBO}}$	$I_{\text{E}}=1\text{mA}, I_{\text{C}}=0$	7			V
C-E Sustain Voltage	$V_{\text{CEO}}(\text{sus})$	$I_{\text{C}}=3\text{A}, L=500\mu\text{H}, I_{\text{B}}=1\text{A}$	800			V
"	$V_{\text{CEX}}(\text{sus})$	$I_{\text{C}}=1\text{A}, I_{\text{B}1}=0.2\text{A}, I_{\text{B}2}=0.2\text{A}, L=2\text{mH}, \text{Clamped}$	800			V
"	$V_{\text{CEX}}(\text{sus})$	$I_{\text{C}}=0.5\text{A}, I_{\text{B}1}=0.1\text{A}, I_{\text{B}2}=0.1\text{A}, L=5\text{mH}, \text{Clamped}$	900			V
Turn-on Time	t_{on}	$I_{\text{C}}=2\text{A}, I_{\text{B}1}=0.4\text{A}, I_{\text{B}2}=0.8\text{A}, R_{\text{L}}=200\text{ohm}, V_{\text{CC}}=400\text{V}$			1.0	μs
Storage Time	t_{stg}	" "			3.0	μs
Fall Time	t_{f}	" "			0.7	μs

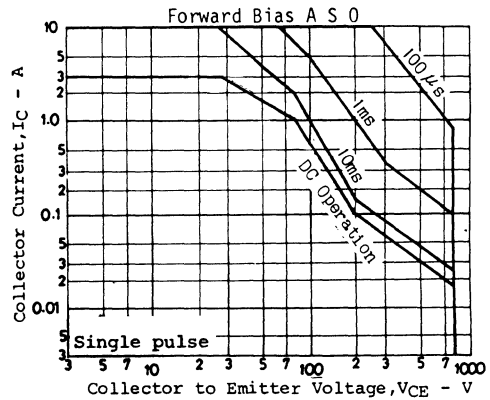
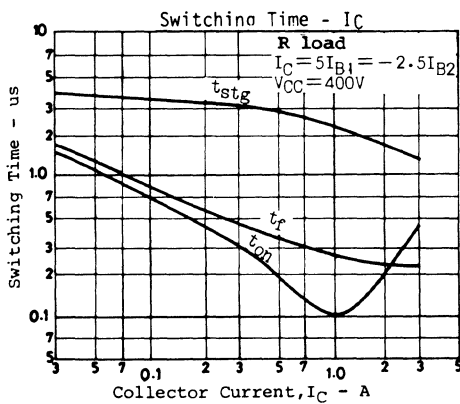
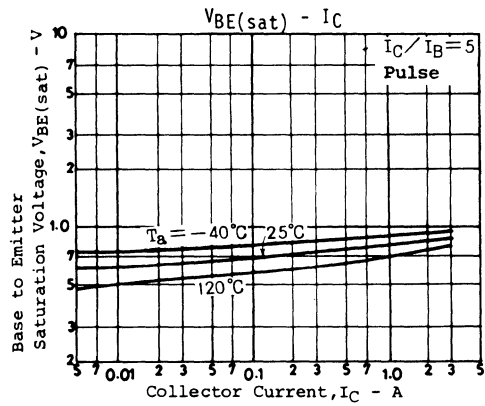
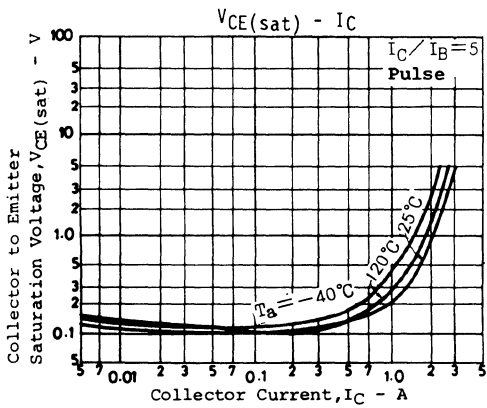
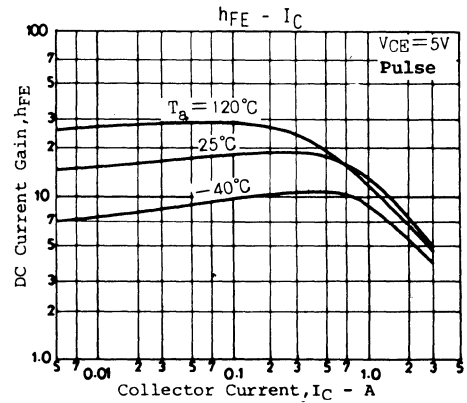
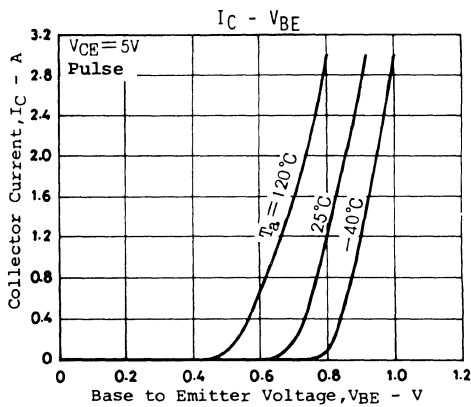
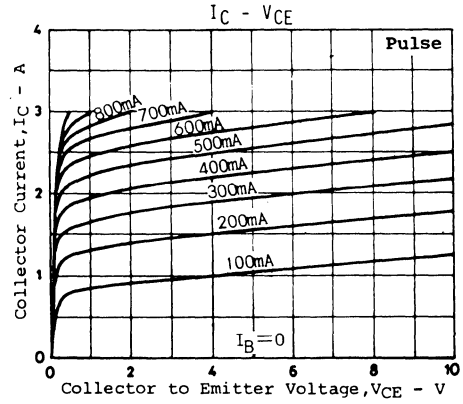
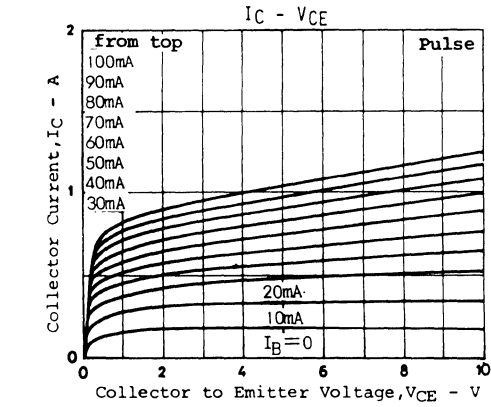
Switching Time Test Circuit

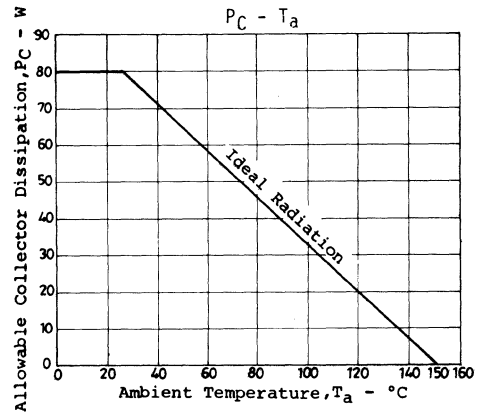
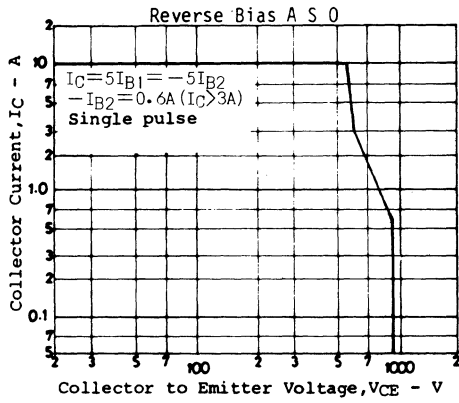


Case Outline 2022
(unit:mm)

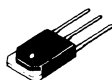


E: Emitter
C: Collector
B: Base





2SC3153



2022

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1072B

Features

- High breakdown voltage ($V_{CBO} \geq 900V$)
- High switching speed
- Wide ASO

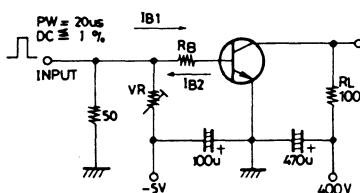
Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	900	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_C	6	A
Peak Collector Current	i_{cp}	20	A
	Pulse, $PW \leq 300\mu s$, Duty Cycle $\leq 10\%$		
Base Current	I_B	3	A
Collector Dissipation	P_C	100	W
	$T_C = 25^\circ C$		
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

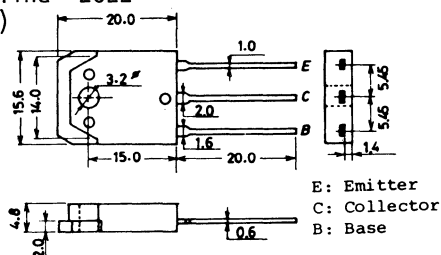
Electrical Characteristics at $T_a = 25^\circ C$

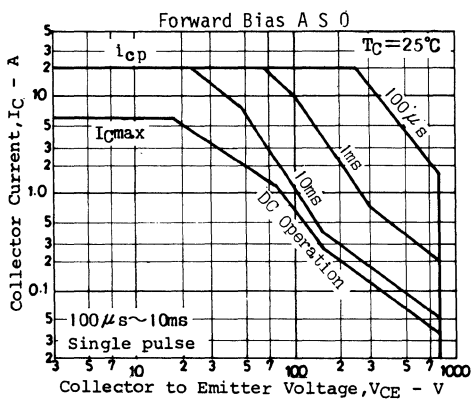
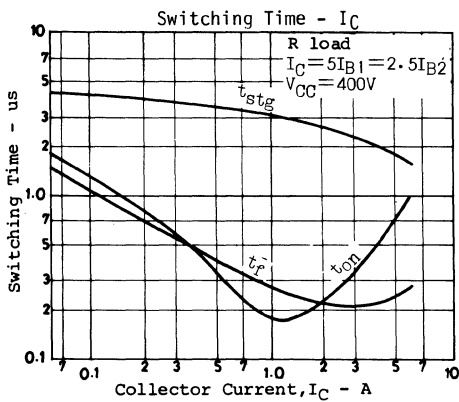
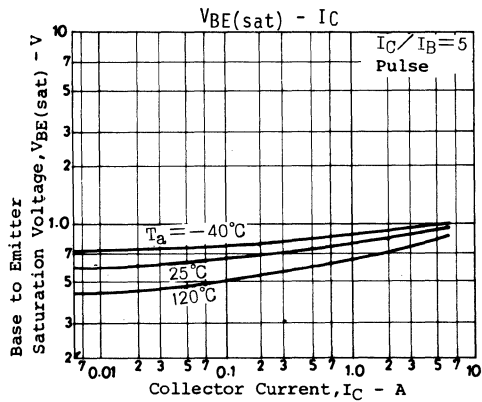
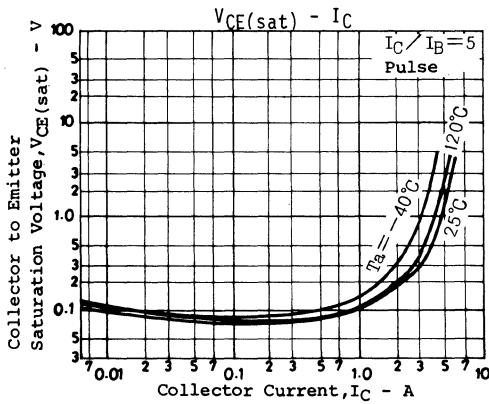
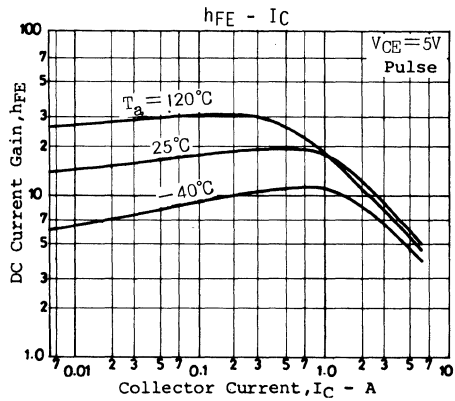
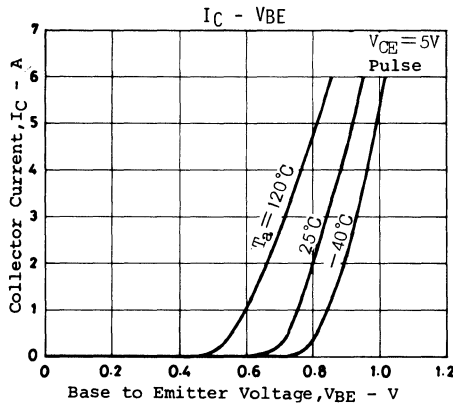
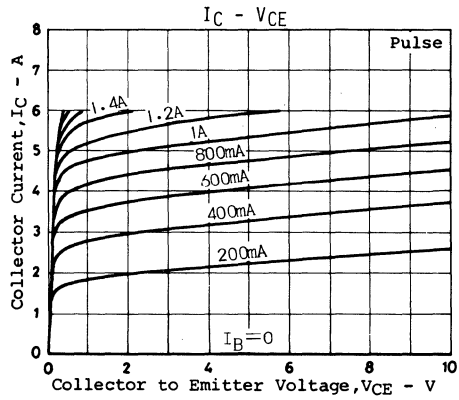
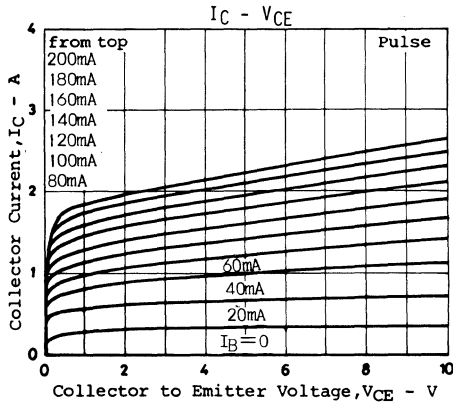
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = 800V, I_E = 0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 5V, I_C = 0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = 5V, I_C = 0.4A$	10			
	$h_{FE}(2)$	$V_{CE} = 5V, I_C = 2A$	8			
Gain Band-width Product	f_T	$V_{CE} = 10V, I_C = 0.4A$		15		MHz
Output Capacitance	C_{ob}	$V_{CB} = 10V, f = 1MHz$		120		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = 3A, I_B = 0.6A$			2.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = 3A, I_B = 0.6A$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 1mA, I_E = 0$	900			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 5mA, R_{BE} = \infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 1mA, I_C = 0$	7			V
C-E Sustain Voltage	$V_{CEO(sus)}$	$I_C = 6A, L = 200\mu H, I_B = 2A$	800			V
"	$V_{CEX(sus)}$	$I_C = 2A, I_{B1} = 0.4A, I_{B2} =$ (1) $-0.4A, L = 1mH, \text{Clamped}$	800			V
"	$V_{CEX(sus)}$	$I_C = 1A, I_{B1} = 0.2A, I_{B2} =$ (2) $-0.2A, L = 2mH, \text{Clamped}$	900			V
Turn-on Time	t_{on}	$I_C = 4A, I_{B1} = 0.8A, I_{B2} = -1.6A,$ $R_L = 100\Omega, V_{CC} = 400V$			1.0	μs
Storage Time	t_{stg}	" " "			3.0	μs
Fall Time	t_f	" " "			0.7	μs

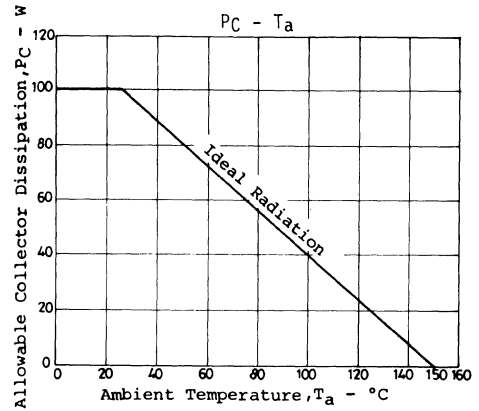
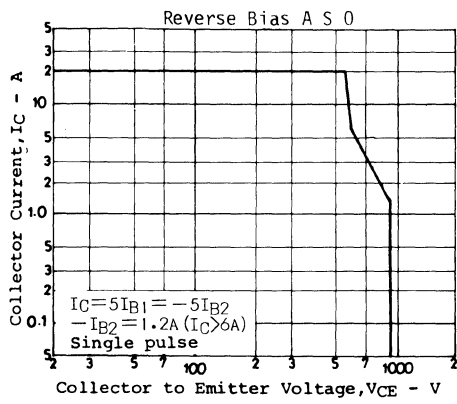
Switching Time Test Circuit



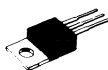
Case Outline 2022 (unit:mm)







2SC3173



2010A

NPN Epitaxial Planar
Silicon Transistor

CRT Display Horizontal Deflection Output Applications

©1309A

Features:

- High switching speed
- Especially suited for use in high-definition CRT display ($V_{CC}=6$ to $12V$)
- Wide ASO and durable against breakdown

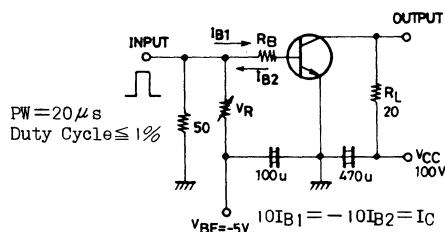
Absolute Maximum Ratings at $T_a=25^{\circ}C$

			unit
Collector to Base Voltage	V_{CBO}	330	V
Collector to Emitter Voltage	V_{CEO}	150	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	7	A
Peak Collector Current	i_{cp}	12	A
Base Current	I_B	4	A
Collector Dissipation	P_C	50	W
Junction Temperature	T_j	150	$^{\circ}C$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}C$

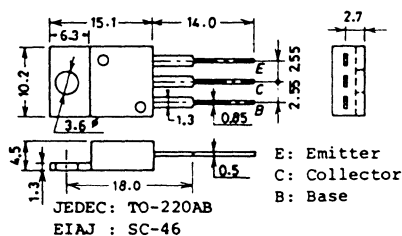
Electrical Characteristics at $T_a=25^{\circ}C$

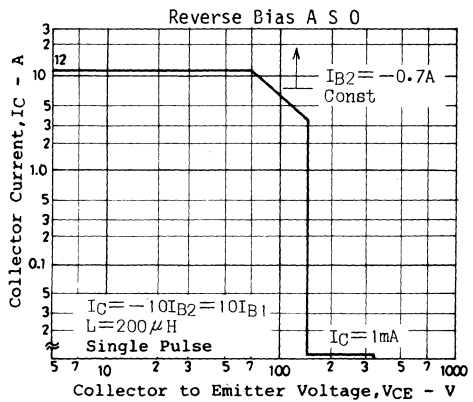
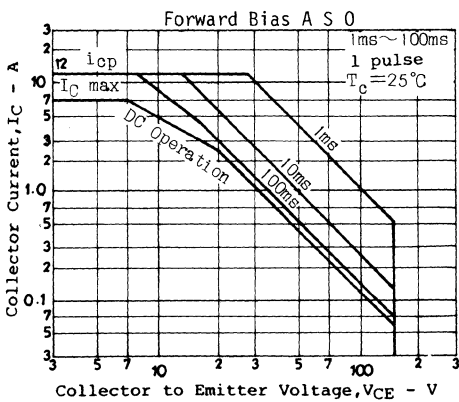
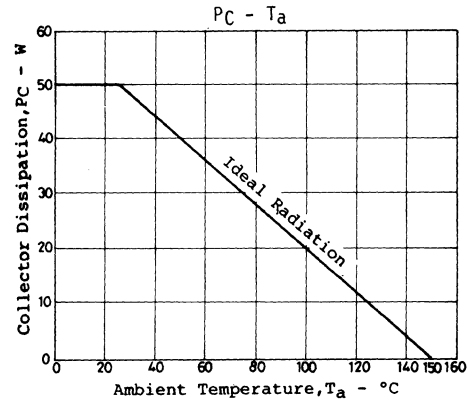
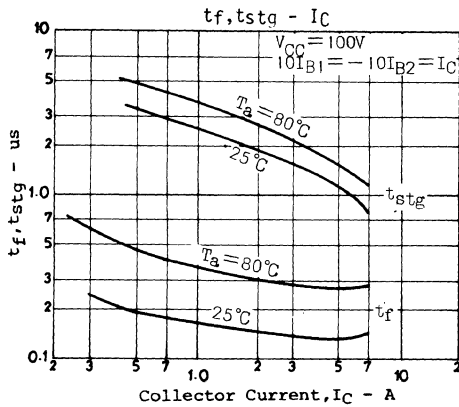
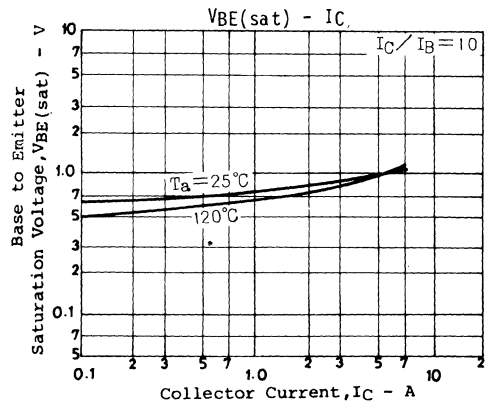
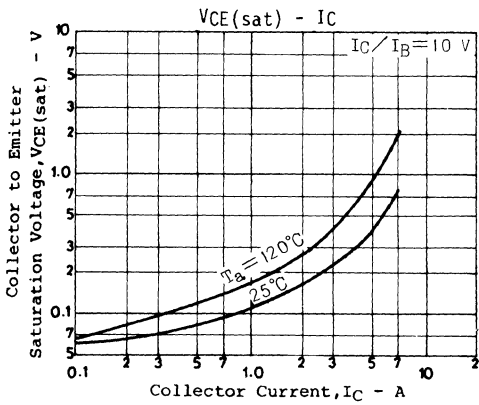
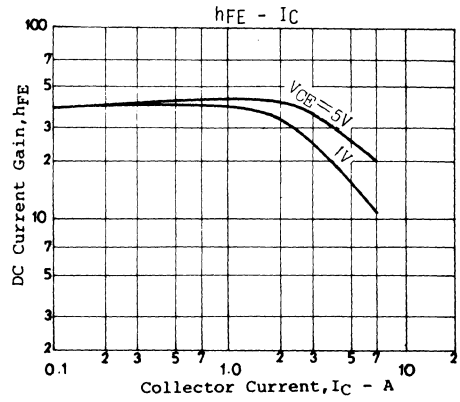
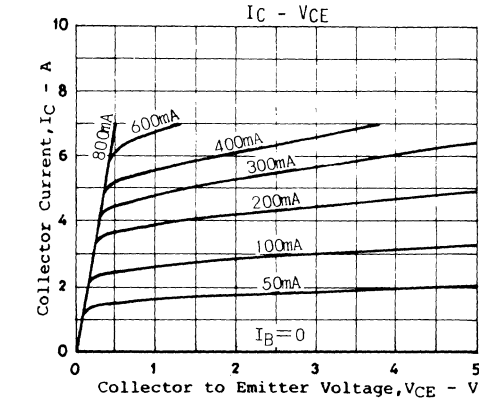
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=200V, I_E=0$			100	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			100	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=1V, I_C=1A$	15			
	$h_{FE}(2)$	$V_{CE}=1V, I_C=5A$	10		50	
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.5A$	10	40		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=5A, I_B=0.5A$			1	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=5A, I_B=0.5A$			1.2	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1mA, I_E=0$	330			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, R_{BE}=\infty$	150			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1mA, I_C=0$	6			V
Fall Time	t_f	$I_C=5A, I_{B1}=-I_{B2}=0.5A$			0.5	μs

Switching Time Test Circuit

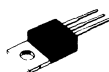


Case Outline 2010A (unit:mm)





2SC3174



2010A

NPN Epitaxial Planar
Silicon Transistor

CRT Display Horizontal Deflection Output Applications (with Damper Diode)

©1310A

Features:

- High switching speed
- Especially suited for use in high-definition CRT display ($V_{CC}=6$ to $12V$)
- Wide ASO and durable against breakdown

Absolute Maximum Ratings at $T_a=25^{\circ}C$

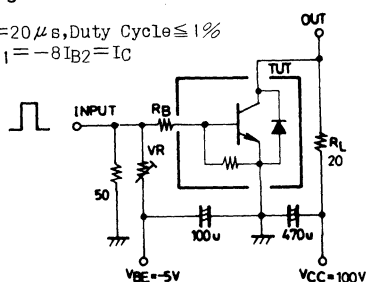
			unit
Collector to Base Voltage	V_{CBO}	330	V
Collector to Emitter Voltage	V_{CEO}	150	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	7	A
Peak Collector Current	i_{cp}	12	A
Base Current	I_B	4	A
Collector Dissipation	P_C	50	W
Junction Temperature	T_j	150	$^{\circ}C$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}C$

Electrical Characteristics at $T_a=25^{\circ}C$

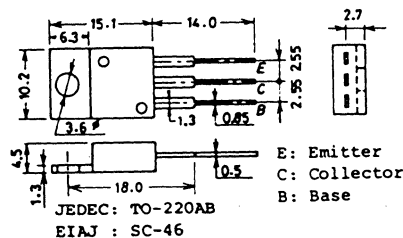
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=200V, I_E=0$			100	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=6V, I_C=0$			400	mA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=1V, I_C=1A$	15			
	$h_{FE}(2)$	$V_{CE}=1V, I_C=5A$	8		40	
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.5A$	10	40		MHz
C-E Saturation Voltage	$V_{CE}(sat)$	$I_C=5A, I_B=0.65A$			1	V
B-E Saturation Voltage	$V_{BE}(sat)$	$I_C=5A, I_B=0.65A$			1.3	V
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C=1mA, I_E=0$	330			V
Diode Forward Voltage	V_F	$I_F=5A$			1.5	V
Fall Time	t_f	$I_C=5A, I_{B1}=-I_{B2}=0.625A$			0.5	us

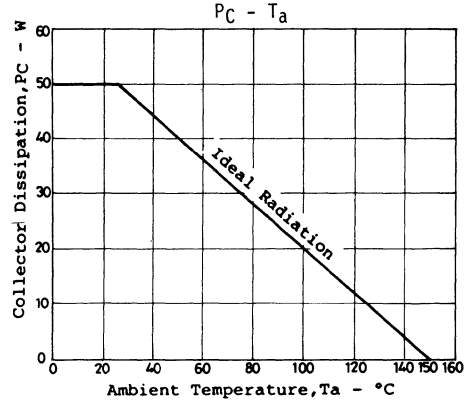
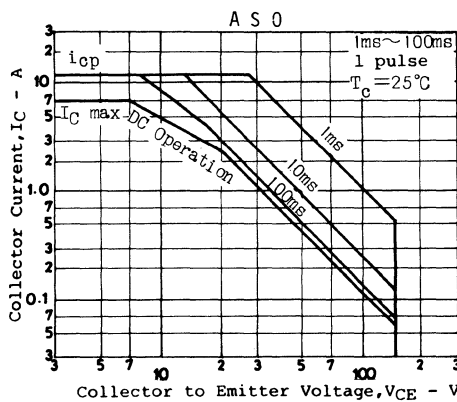
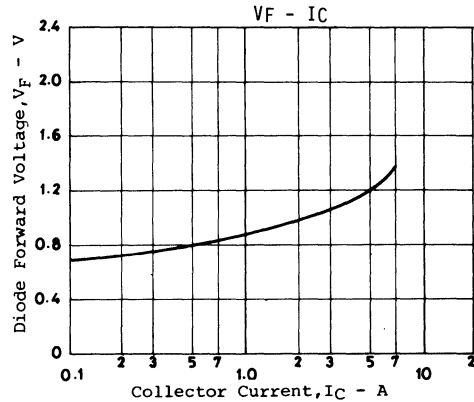
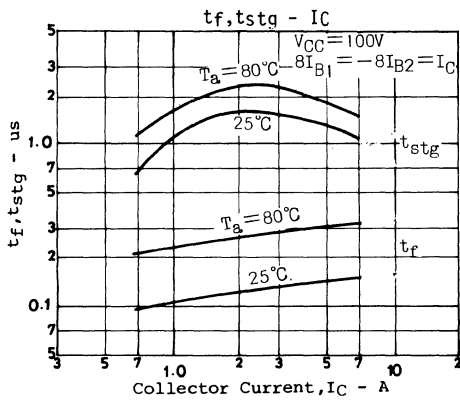
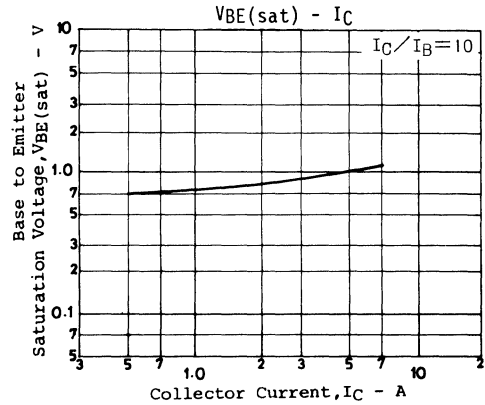
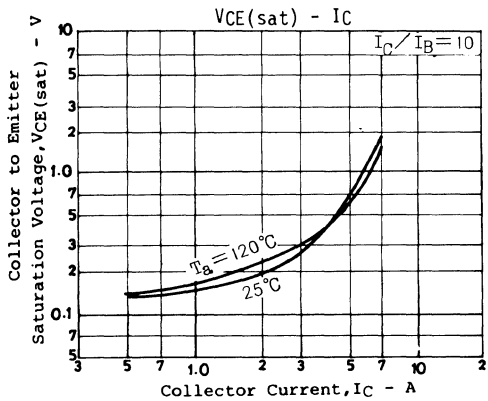
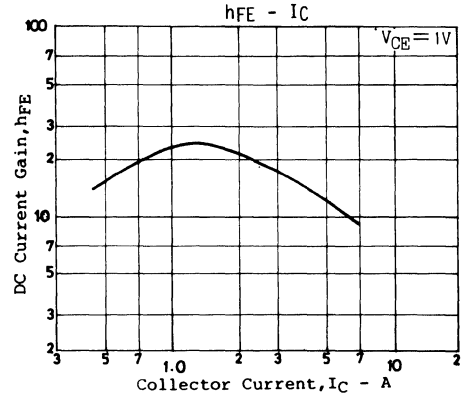
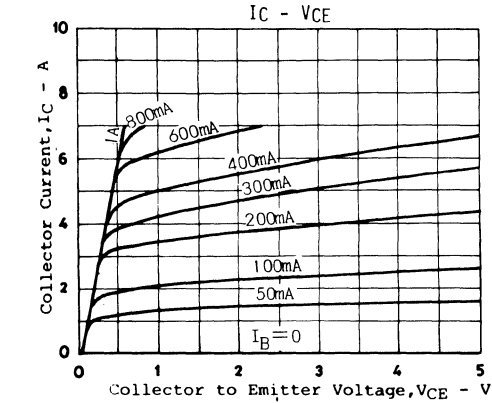
Switching Time Test Circuit

$PW=20\mu s$, Duty Cycle $\leq 1\%$
 $8I_{B1}=-8I_{B2}=I_C$

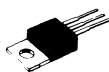


Case Outline 2010A (unit:mm)





2SC3175



2010A

NPN Epitaxial Planar
Silicon Transistor

CRT Display Horizontal Deflection Output Applications

©1311A

Features:

- High switching speed
- Especially suited for use in high-definition CRT display ($V_{CC}=12$ to $24V$)
- Wide ASO and durable against breakdown

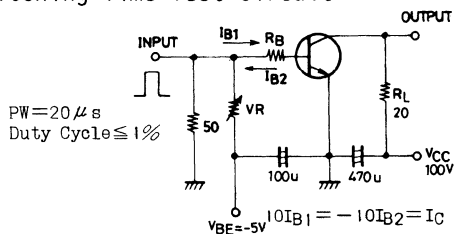
Absolute Maximum Ratings at $T_a=25^{\circ}C$

			unit
Collector to Base Voltage	V_{CBO}	400	V
Collector to Emitter Voltage	V_{CEO}	200	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	7	A
Peak Collector Current	i_{cp}	12	A
Base Current	I_B	4	A
Collector Dissipation	P_C	50	W
Junction Temperature	T_j	150	$^{\circ}C$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}C$

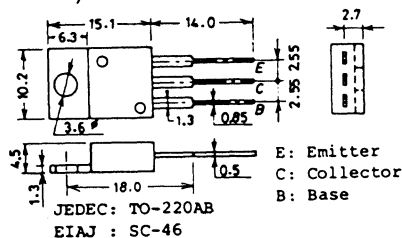
Electrical Characteristics at $T_a=25^{\circ}C$

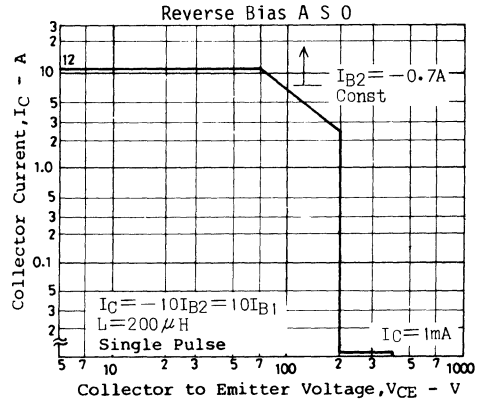
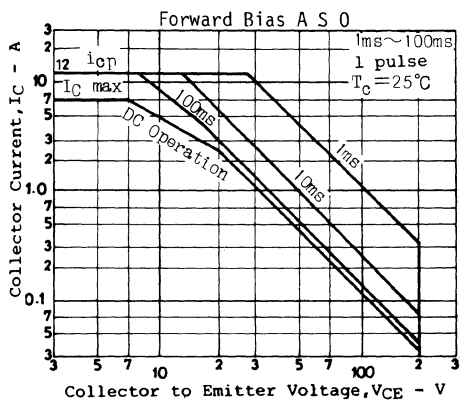
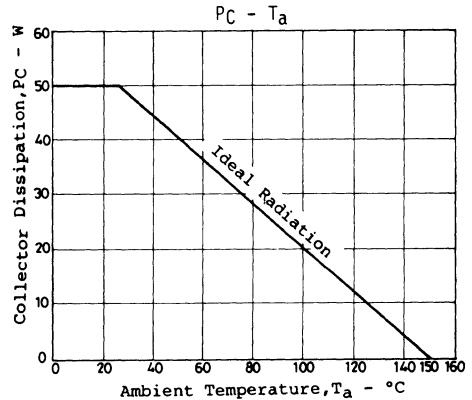
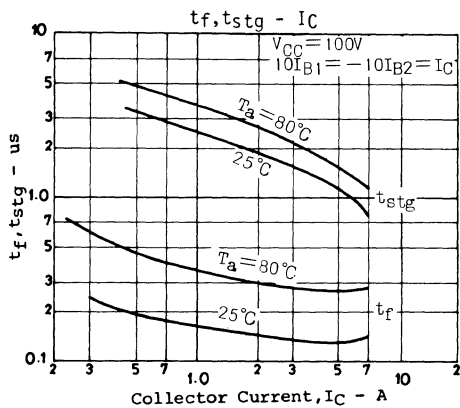
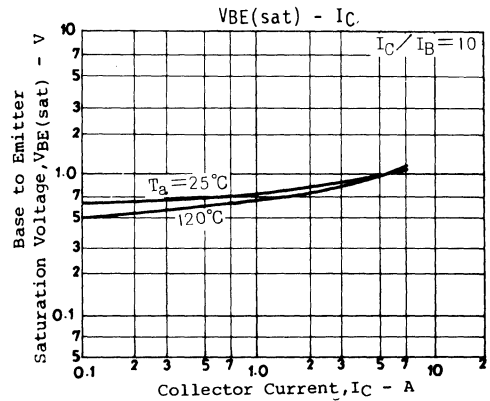
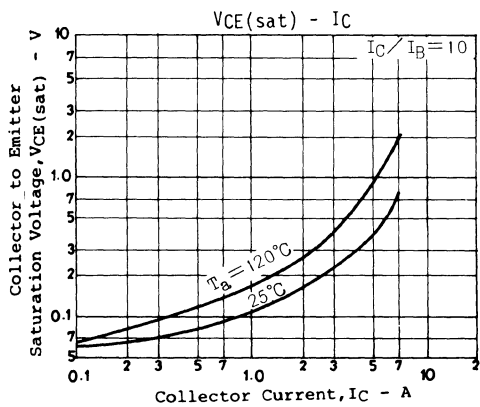
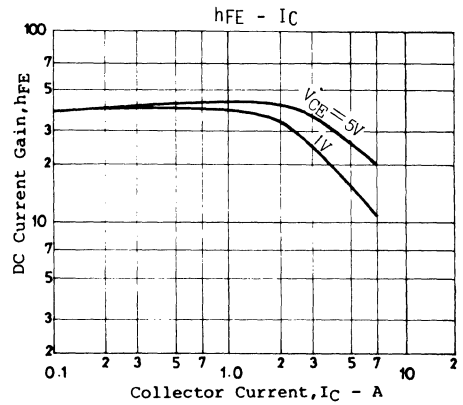
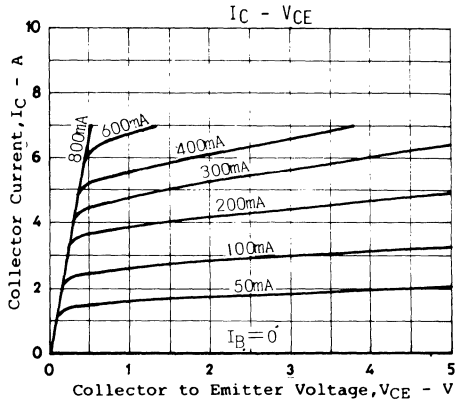
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=200V, I_E=0$			100	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			100	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=1V, I_C=1A$	15			
	$h_{FE}(2)$	$V_{CE}=1V, I_C=5A$	10		50	
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.5A$	10	40		MHz
C-E Saturation Voltage	$V_{CE}(sat)$	$I_C=5A, I_B=0.5A$			1	V
B-E Saturation Voltage	$V_{BE}(sat)$	$I_C=5A, I_B=0.5A$			1.2	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1mA, I_E=0$	400			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, R_{BE}=\infty$	200			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1mA, I_C=0$	6			V
Fall Time	t_f	$I_C=5A, I_{B1}=-I_{B2}=0.5A$			0.5	μs

Switching Time Test Circuit

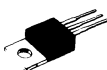


Case Outline 2010A (unit:mm)





2SC3176



2010A

NPN Epitaxial Planar
Silicon Transistor

CRT Display Horizontal Deflection Output Applications (with Damper Diode)

©1312A

Features:

- High switching speed
- Especially suited for use in high-definition CRT display ($V_{CC}=12$ to $24V$)
- Wide ASO and durable against breakdown

Absolute Maximum Ratings at $T_a=25^{\circ}C$

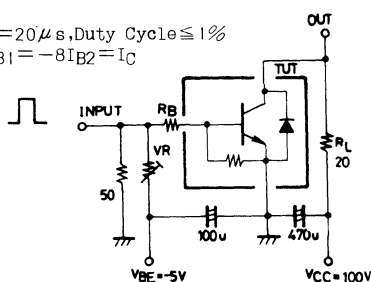
			unit
Collector to Base Voltage	V_{CBO}	400	V
Collector to Emitter Voltage	V_{CEO}	200	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	7	A
Peak Collector Current	i_{cp}	12	A
Base Current	I_B	4	A
Collector Dissipation	P_C $T_c=25^{\circ}C$	50	W
Junction Temperature	T_j	150	$^{\circ}C$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}C$

Electrical Characteristics at $T_a=25^{\circ}C$

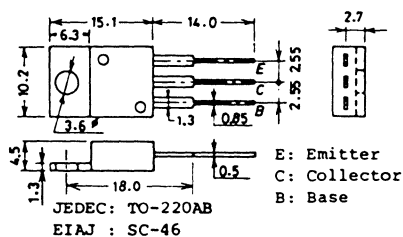
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=200V, I_E=0$			100	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=6V, I_C=0$			400	mA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=1V, I_C=1A$	15			
	$h_{FE}(2)$	$V_{CE}=1V, I_C=5A$	8		40	
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.5A$	10	40		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=5A, I_B=0.65A$			1	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=5A, I_B=0.65A$			1.3	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1mA, I_E=0$	400			V
Diode Forward Voltage	V_F	$I_F=5A$			1.5	V
Fall Time	t_f	$I_C=5A, I_{B1}=-I_{B2}=0.625A$			0.5	us

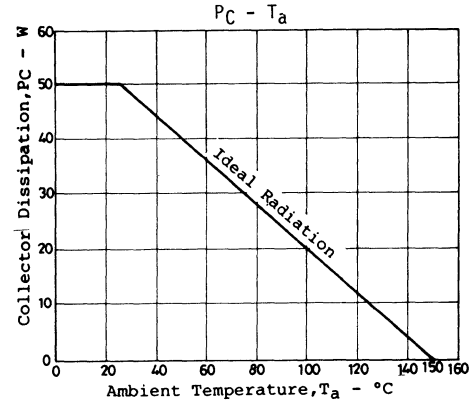
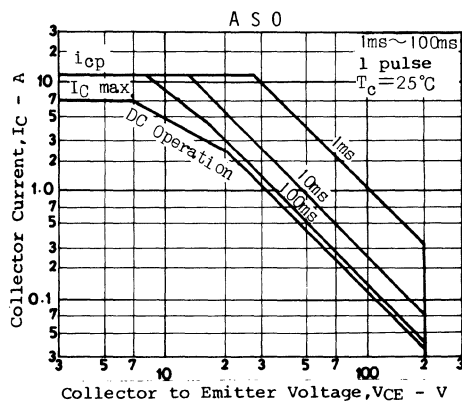
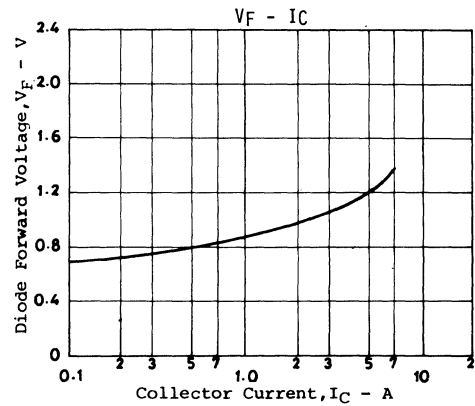
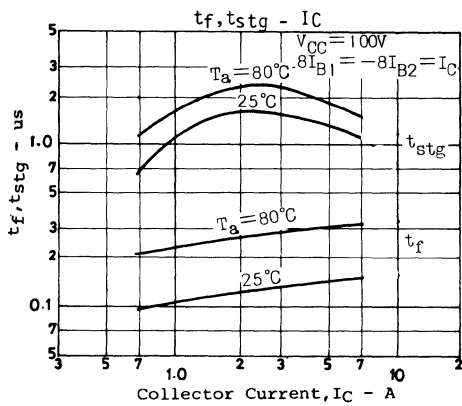
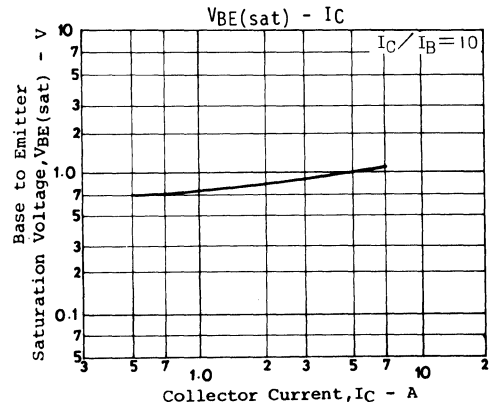
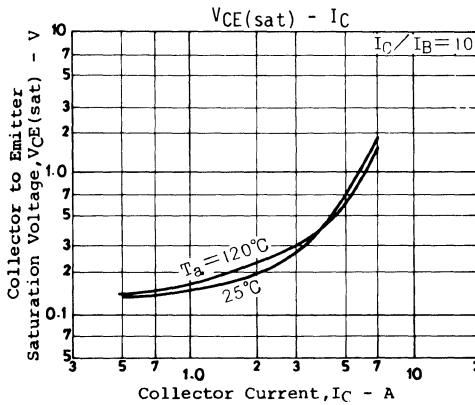
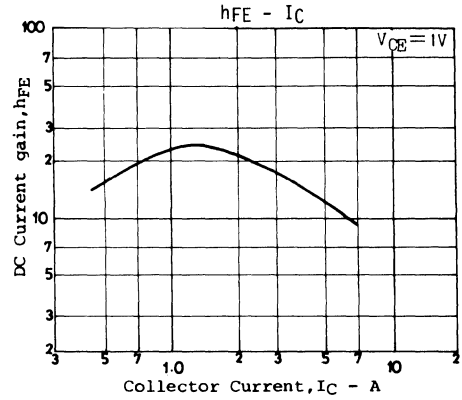
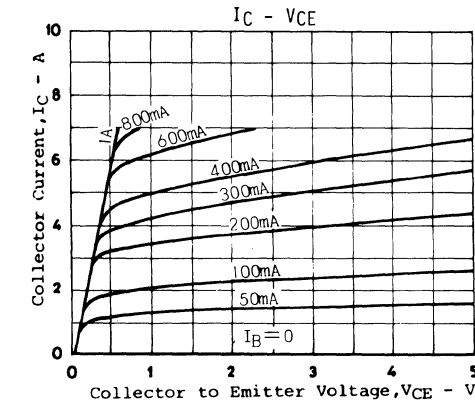
Switching Time Test Circuit

$PW=20\mu s$, Duty Cycle $\leq 1\%$
 $8I_{B1}=-8I_{B2}=I_C$

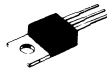


Case Outline 2010A (unit:mm)





2SC3183



2010A

NPN Triple Diffused Planar
Silicon Transistor

High Speed Switching Applications

©1251

Features

1. High breakdown voltage ($V_{CBO} \geq 900V$).
2. High switching speed.
3. Wide ASO.

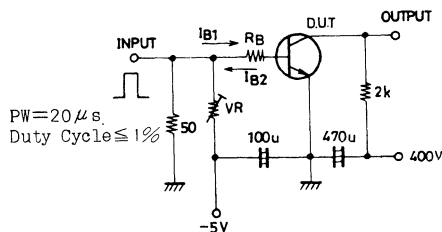
Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	900	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_C	0.2	A
Peak Collector Current	i_{cp}	$PW \leq 300\mu s, \text{Duty Cycle} \leq 10\%$	A
Collector Dissipation	P_C	25	W
Junction Temperature	T_J	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

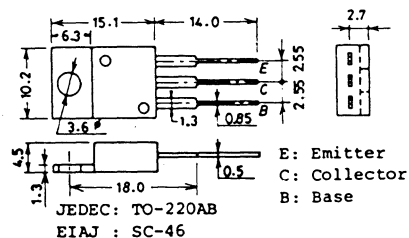
Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = 800V, I_E = 0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 5V, I_C = 0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = 5V, I_C = 20mA$	10			
	$h_{FE}(2)$	$V_{CE} = 5V, I_C = 100mA$	8			
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = 100mA, I_B = 20mA$			2.0	V
Gain Bandwidth Product	f_T	$V_{CE} = 10V, I_C = 20mA$		15		MHz
Output Capacitance	c_{ob}	$V_{CB} = 10V, f = 1MHz$		10		pF
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 1mA, I_E = 0$	900			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 1mA, R_{BE} = \infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 1mA, I_C = 0$	7			V
C-E Sustain Voltage	$V_{CEO(sus)}$	$I_C = 0.2A, I_B = 0.04A, L = 10mH$	800			V
"	$V_{CEX(sus)}$	$I_C = 0.2A, I_{B1} = 0.04A, I_{B2} = -0.04A, L = 10mH, \text{clamped}$	900			V
Turn-on Time	t_{on}	$I_C = 200mA, I_{B1} = 40mA, I_{B2} = -80mA$			1.0	μs
Storage Time	t_{stg}	"			3.0	μs
Fall Time	t_f	"			1.0	μs

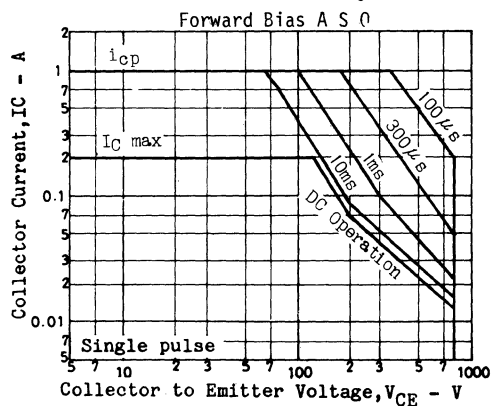
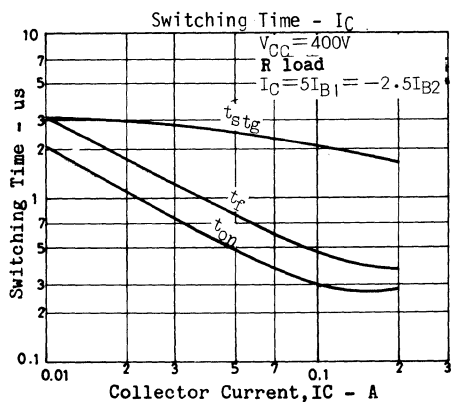
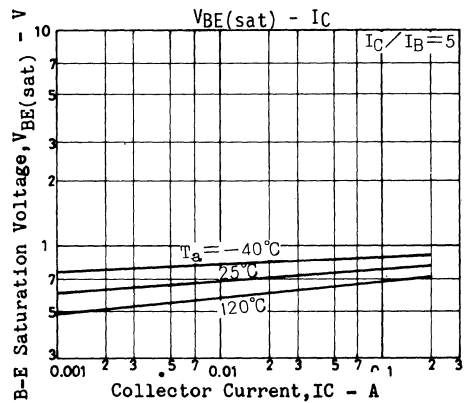
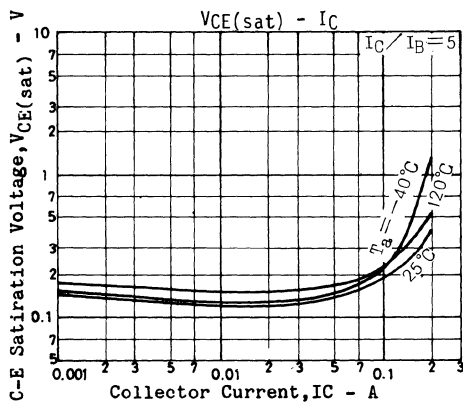
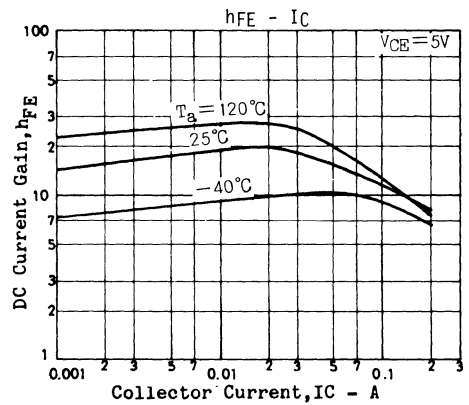
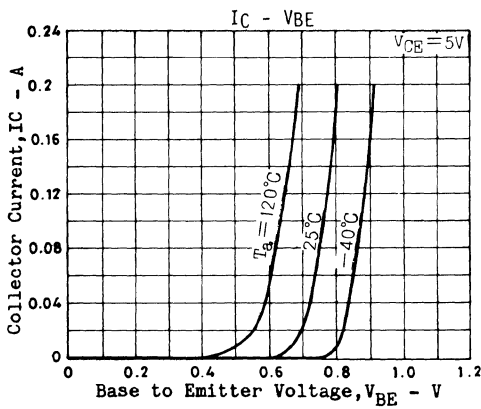
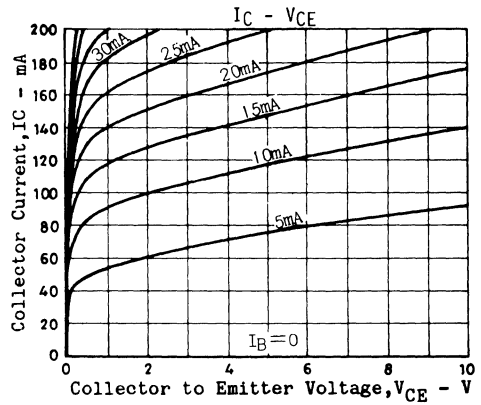
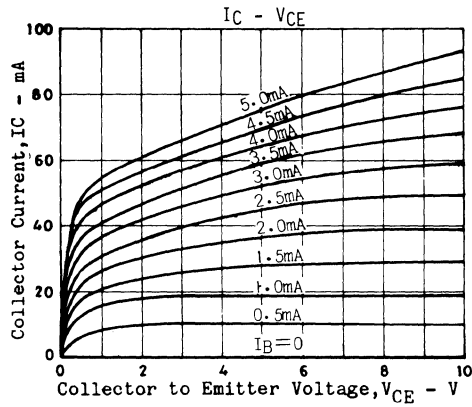
Switching Time Test Circuit

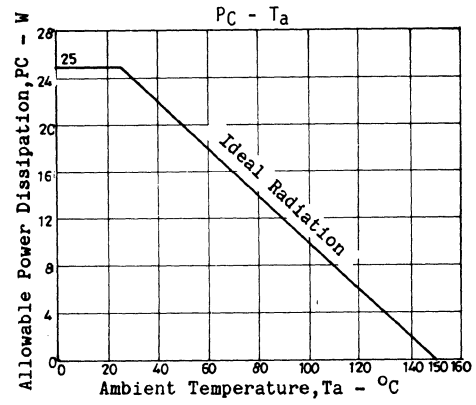
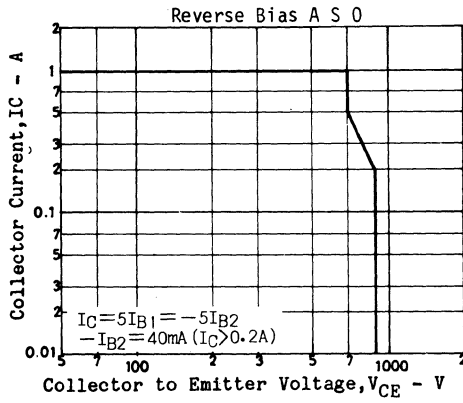


Case Outline 2010A (unit:mm)

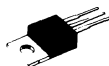


9073KI, TS No.1251-1/3





2SC3184



2010A

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1252

Features

- High breakdown voltage ($V_{CBO} \geq 900V$).
- High switching speed.
- Wide ASO.

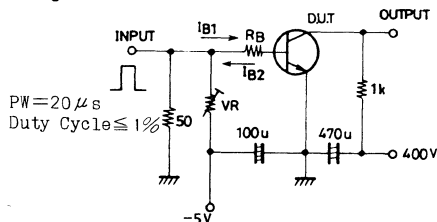
Absolute Maximum Ratings/ $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	900	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_C	0.5	A
Peak Collector Current	i_{cp}	$PW \leq 300\mu s$, Duty Cycle $\leq 10\%$	2 A
Collector Dissipation	P_C	$T_c = 25^\circ C$	30 W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics/ $T_a = 25^\circ C$

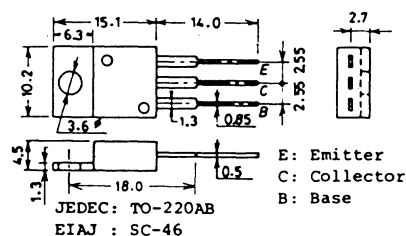
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = 800V, I_E = 0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 5V, I_C = 0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE} = 5V, I_C = 60mA$	10			
	$h_{FE}(2)$	$V_{CE} = 5V, I_C = 300mA$	8			
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 300mA, I_B = 60mA$			2	V
Gain Band-width Product	f_T	$V_{CE} = 10V, I_C = 60mA$		15		MHz
Common Base Output Capacitance	c_{ob}	$V_{CB} = 10V, f = 1MHz$		20		pF
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 1mA, I_E = 0$	900			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 1mA, R_{BE} = \infty$	800			V
Collector to Emitter Sustain Voltage	$V_{CEO(sus)}$	$I_C = 0.5A, I_B = 0.1A, L = 5mH$	800			V
"	$V_{CEX(sus)}$	$I_C = 0.5A, I_{B1} = 0.1A, I_{B2} = -0.1A$ $L = 5mH$, clamped	900			V
Turn-on Time	t_{on}	$I_C = 400mA, I_{B1} = 80mA, I_{B2} = -160mA$			1.0	μs
Storage Time	t_{stg}	" "			3.0	μs
Fall Time	t_f	" "			1.0	μs

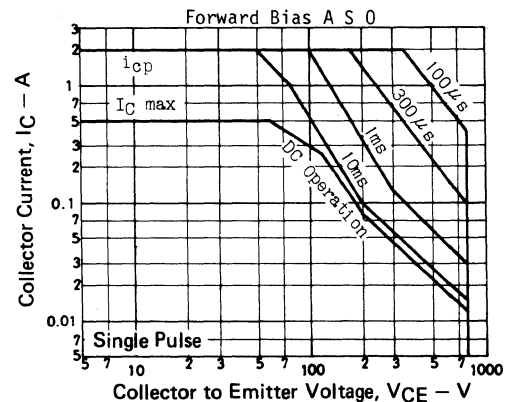
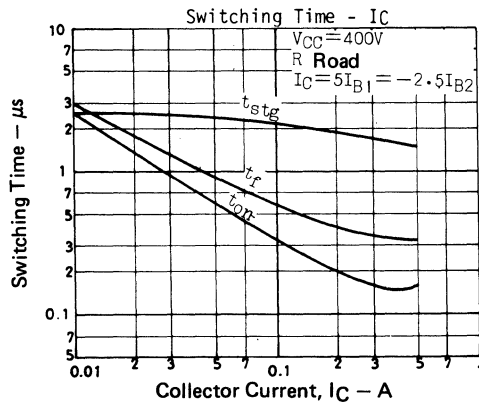
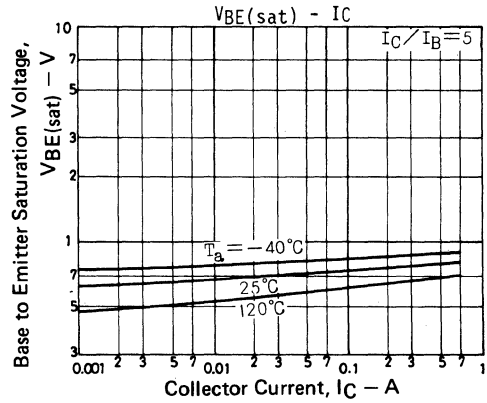
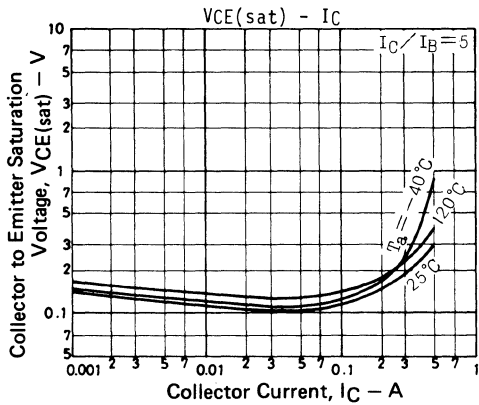
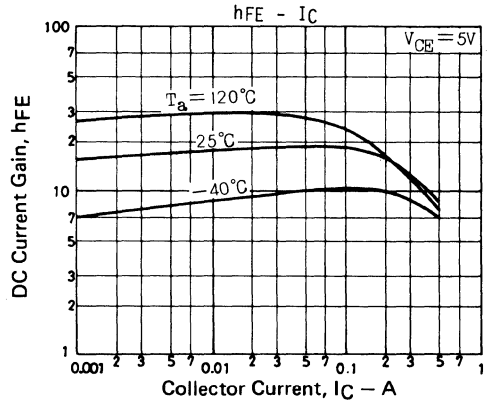
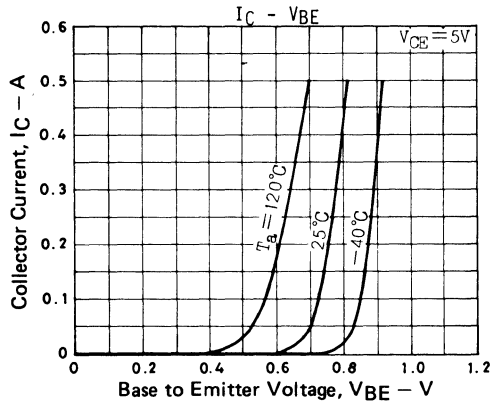
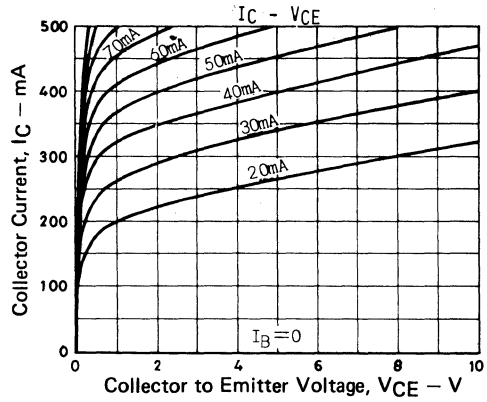
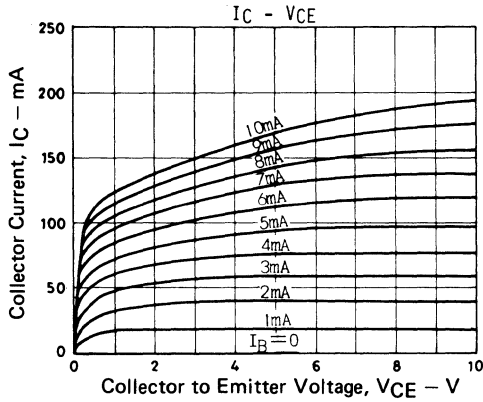
Switching Time Test Circuit

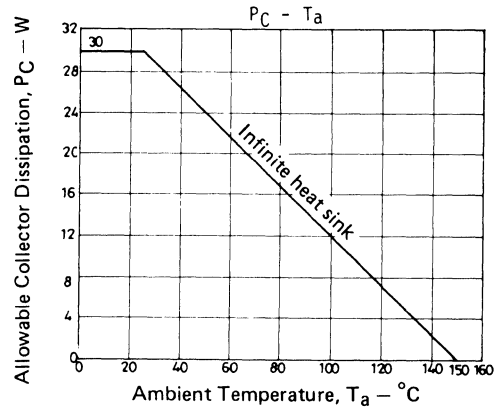
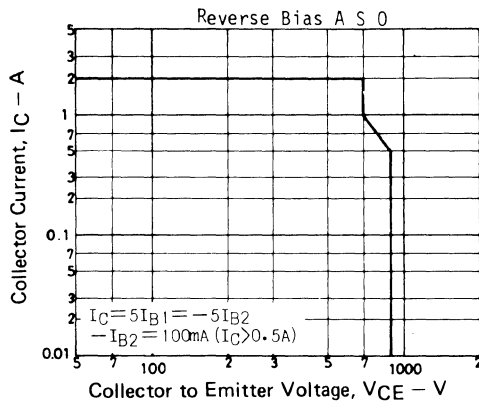


Case Outline 2010A

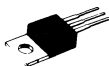
(unit: mm)







2SC3189



2010A

NPN Epitaxial Planar
Silicon Transistor

CRT Display Horizontal Deflection Output Applications

©1313

Features

- . High switching speed.
- . Especially suited for high-definition CRT displays.
- . Wide ASO and highly resistant to breacdown.

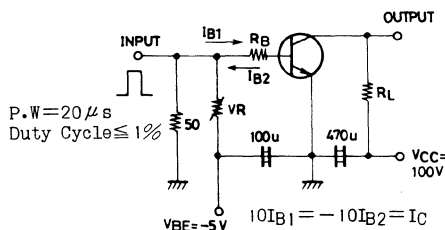
Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	250	V
Collector to Emitter Voltage	V_{CE0}	100	V
Emitter to Base Voltage	V_{EB0}	6	V
Collector Current	I_C	7.5	A
Peak Collector Current	i_{cp}	15	A
Base Current	I_B	4	A
Collector Dissipation	P_C	50	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

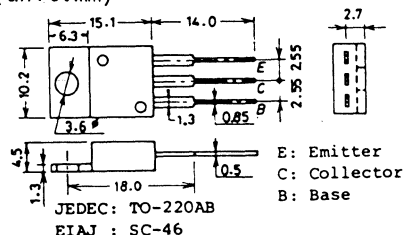
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=200\text{V}, I_E=0$			100	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5\text{V}, I_C=0$			100	μA
DC Current Gain	h_{FE}	$V_{CE}=5\text{V}, I_C=5\text{A}$	15		75	
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=0.5\text{A}$	10	40		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=5\text{A}, I_B=0.5\text{A}$			1.2	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=5\text{A}, I_B=0.5\text{A}$			1.2	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1\text{mA}, I_E=0$	250			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1\text{mA}, R_{BE}=\infty$	100			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1\text{mA}, I_C=0$	6			V
Fall Time	t_f	$I_C=5\text{A}, I_{B1}=-I_{B2}=0.5\text{A}$			0.5	μs

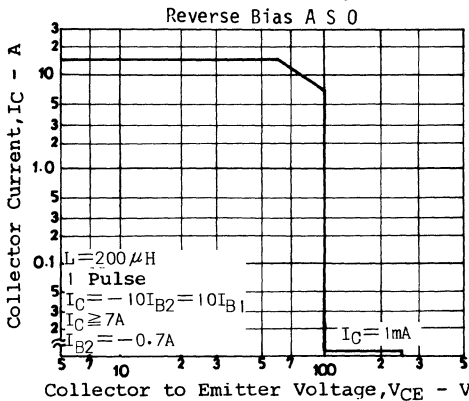
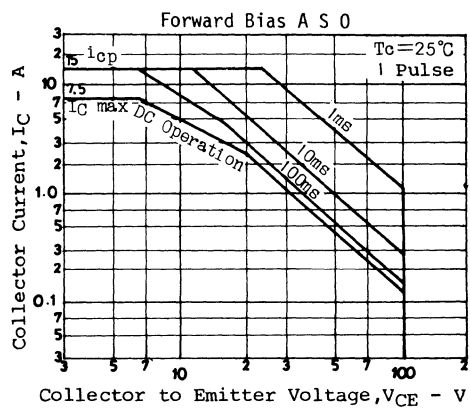
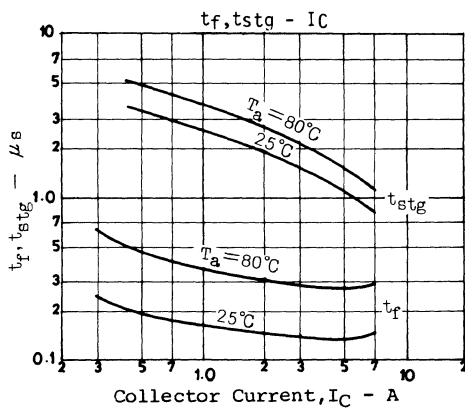
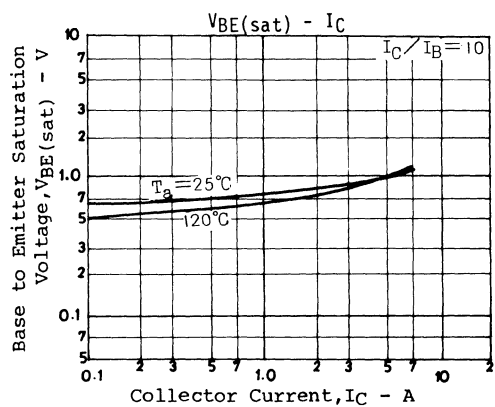
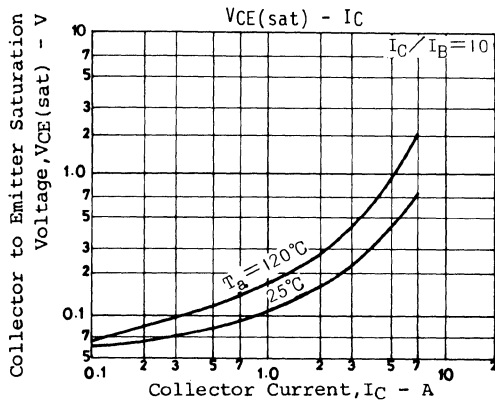
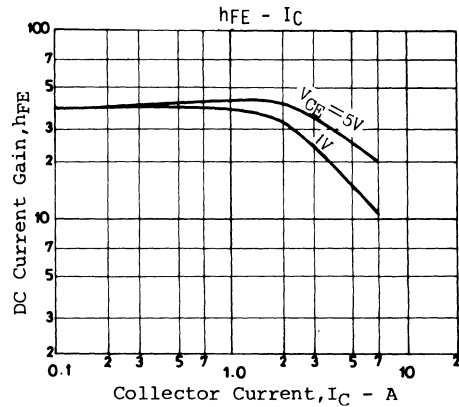
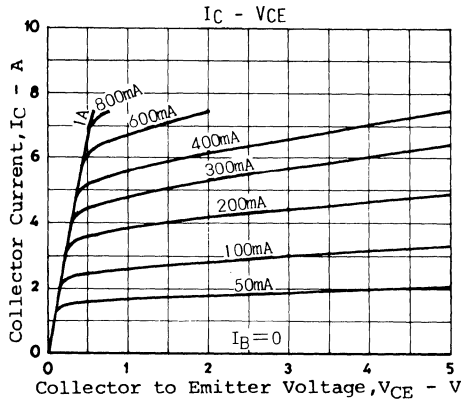
Switching Time Test Circuit



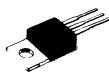
Case Outline 2010A (unit:mm)



0064MY, ST No.1313-1/2



2SC3253



2010A

NPN/PNP Epitaxial Planar
Silicon Transistors**2SA1289**

High Current Switching Applications

©1199

Applications

- . Various inductance lamp drivers for electrical equipment.
- . Inverters, converters (strobo, flash, fluorescent lamp lighting circuit).
- . Power amp. (high power car stereo, motor controller).
- . High-speed switching (switching regulator, driver).

Features

- . Low saturation voltage.
- . Excellent current dependence of h_{FE} .
- . Short switching time.

(): 2SA1289

Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)80	V
Collector to Emitter Voltage	V_{CEO}	(-)60	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)5	A
Peak Collector Current	i_{cp}	(-)7	A
Collector Dissipation	P_C	30	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

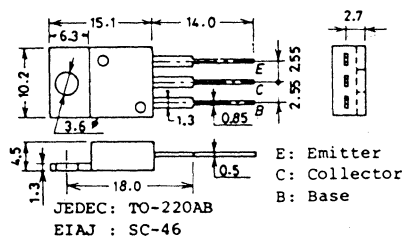
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	mA
DC Current Gain	h_{FE}^*	$V_{CE}=(-)2\text{V}, I_C=(-)1\text{A}$	70*		280*	
Gain Bandwidth Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$		100		MHz

* The 2SA1289/2SC3253 are classified by 1A h_{FE} as follows:

70	Q	140	100	R	200	140	S	280
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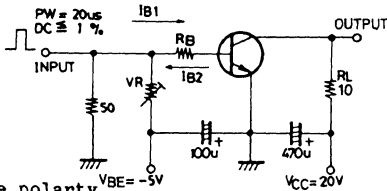
Case Outline 2010A (unit:mm)



D064MY, TS No.1199-1/3

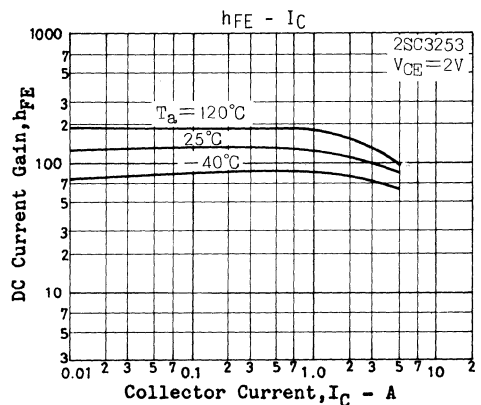
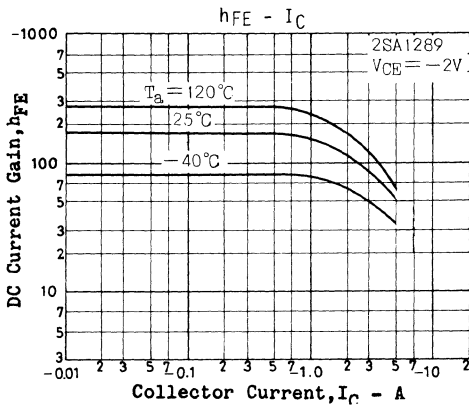
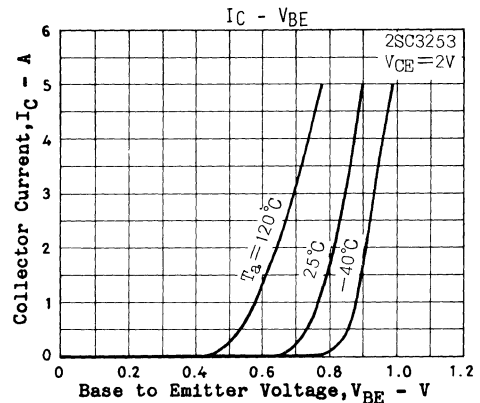
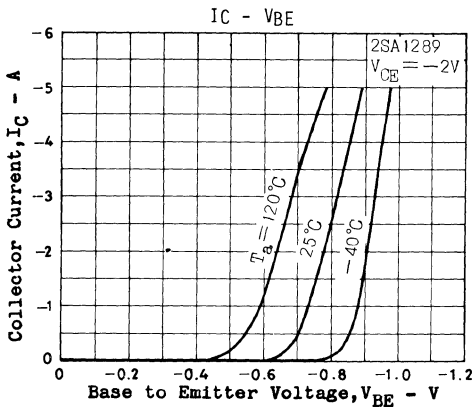
		min	typ	max	unit
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$ $I_C=(-)2.5A$, $I_B=(-)0.125A$			$(-)0.4$	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$ $I_C=(-)1mA$, $I_E=0$	$(-)80$			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$ $I_C=(-)1mA$, $I_{BE}=\infty$	$(-)60$			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$ $I_E=(-)1mA$, $I_C=0$	$(-)5$			V
Turn-on Time	t_{on} at specified test circuit	0.1			us
Storage Time	t_{stg}	0.5			us
Fall Time	t_f	0.1			us

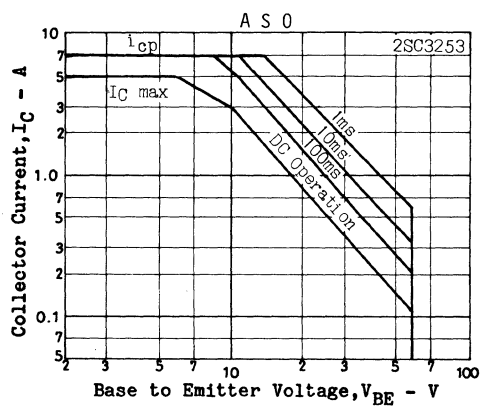
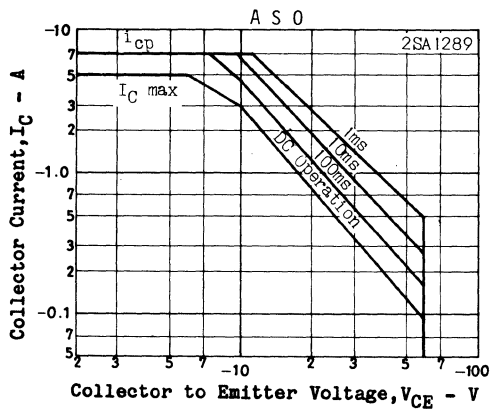
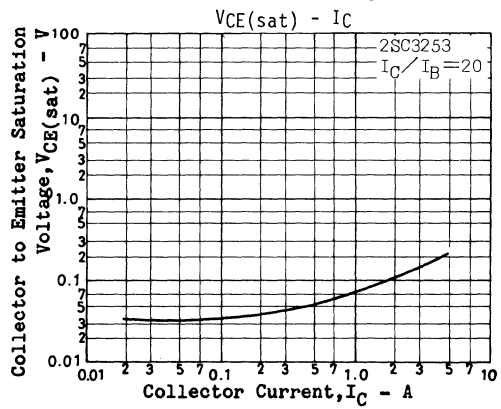
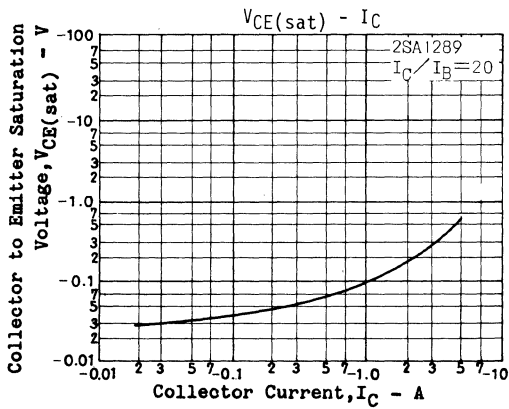
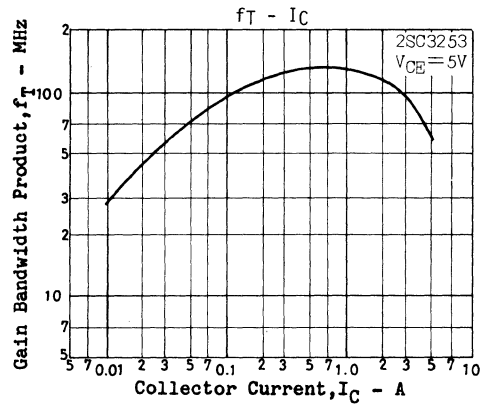
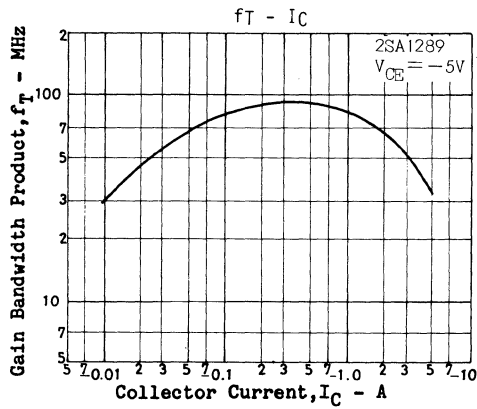
Switching Time Test Circuit



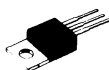
For PNP, the polarity is reversed

$$20I_{B1} = -20I_{B2} = I_C = 2A$$





2SC3254



2010A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1290

High Current Switching Applications

©1200

Applications

- Various inductance lamp drivers for car applications.
- Inverters, converters (strobo, flash, fluorescent lamp lighting circuit).
- Power amp (high power car stereo, motor controller).
- High-speed switching (switching regulator, driver).

Features

- Low saturation voltage.
- Excellent current dependence of h_{FE} .
- Short switching time

(): 2SA1290

Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-) 80	V
Collector to Emitter Voltage	V_{CEO}	(-) 60	V
Emitter to Base Voltage	V_{EBO}	(-) 5	V
Collector Current	I_C	(-) 7	A
Peak Collector Current	i_{cp}	(-) 10	A
Collector Dissipation	P_C	35	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to $+150$	$^\circ\text{C}$

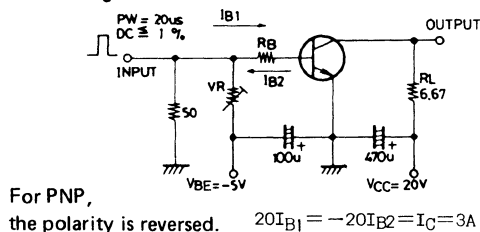
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			(-) 0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-) 0.1	mA
DC Current Gain	f_{FE}^*	$V_{CE}=(-)2\text{V}, I_C=(-)1\text{A}$	70^*		280^*	
Gain Band-width product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$		100		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)3.5\text{A}, I_B=(-)0.175\text{A}$			(-) 0.4	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)1\text{mA}, I_E=0$	(-) 80			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	(-) 60			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)1\text{mA}, I_C=0$	(-) 5			V
Turn-on Time	t_{on}	at specified test circuit		0.1		μs
Storage Time	t_{stg}	"		0.5		μs
Fall Time	t_f	"		0.1		μs

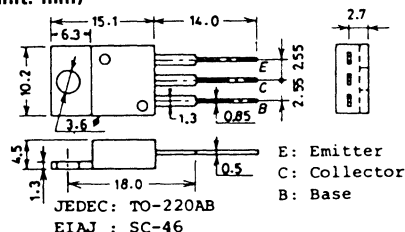
*The 2SA1290/2SC3254 are classified by 1A h_{FE} as follows:

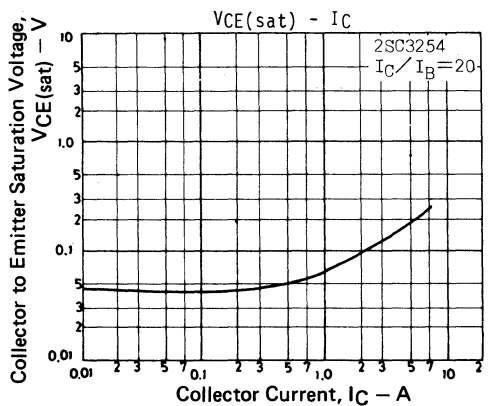
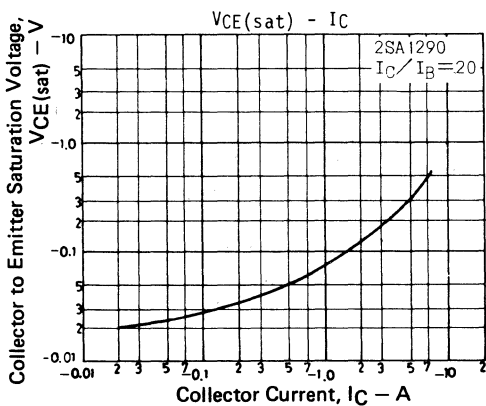
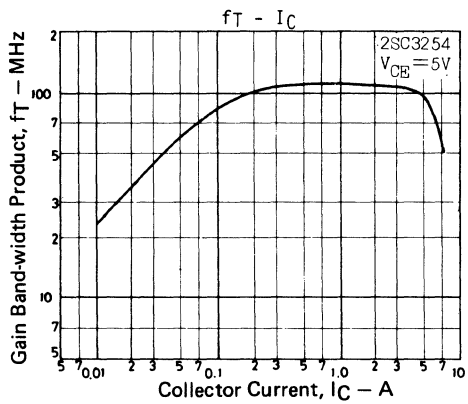
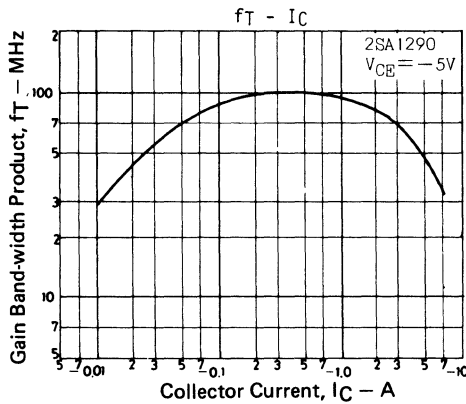
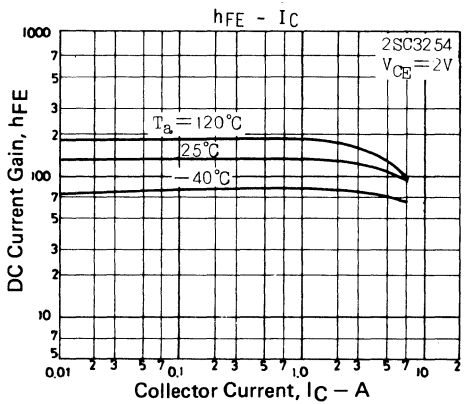
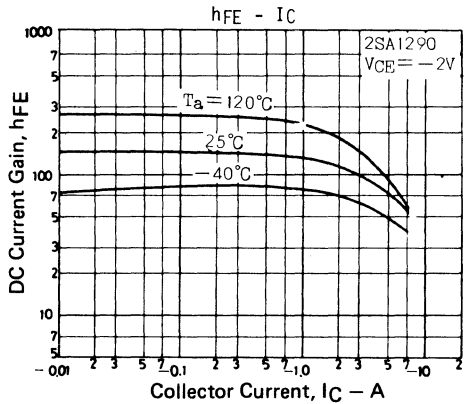
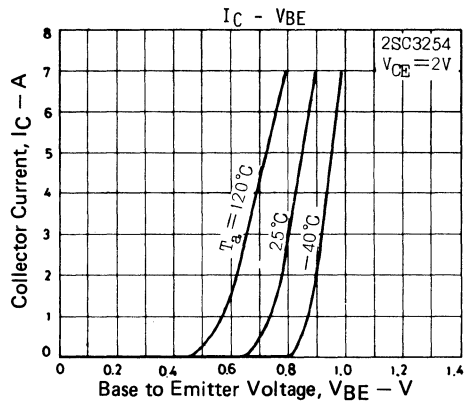
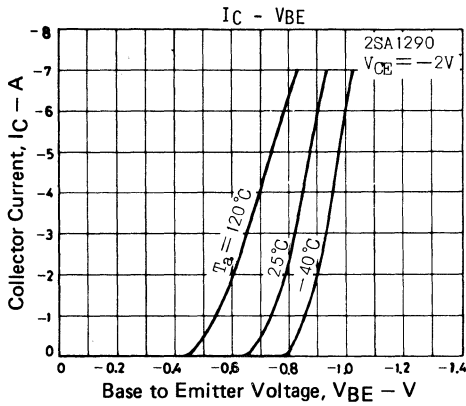
70	Q	140	100	R	200	140	S	280
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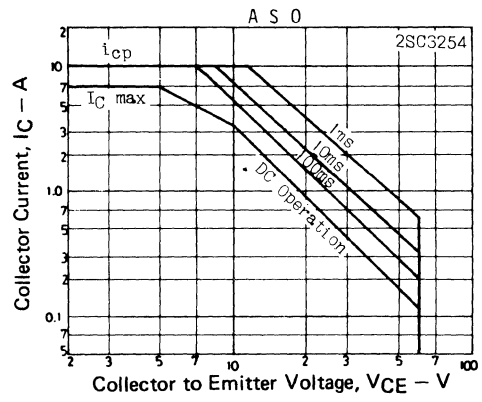
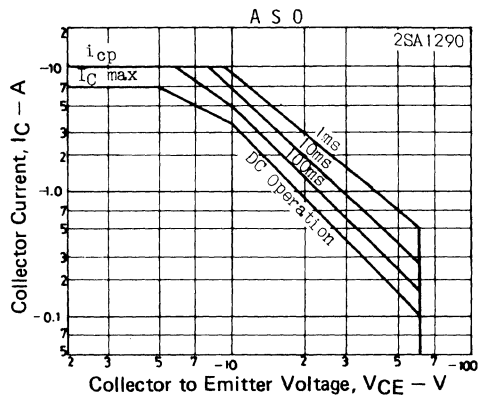
Switching Time Test Circuit



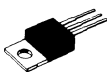
Case Outline 2010A (unit: mm)







2SC3255



2010A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1291

High Current Switching Applications

©1201

Applications

- Various inductance lamp drivers for car applications.
- Inverters, converters (strobo, flash, fluorescent lamp lighting circuit).
- Power amp (high power car stereo, motor controller).
- High-speed switching (switching regulator, driver).

Features

- Low saturation voltage.
- Excellent current dependence of h_{FE} .
- Short switching time

(): 2SA1291

Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)80	V
Collector to Emitter Voltage	V_{CEO}	(-)60	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)10	A
Peak Collector Current	i_{cp}	(-)12	A
Collector Dissipation	P_C	$T_C=25^\circ\text{C}$ 40	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

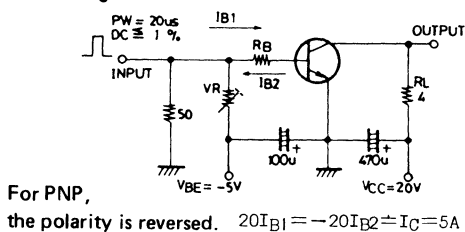
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	mA
DC Current Gain	f_{FE}^*	$V_{CE}=(-)2\text{V}, I_C=(-)1\text{A}$	70*		280*	
Gain Band-width product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$		100		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{A}, I_B=(-)0.25\text{A}$			(-)0.4	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)1\text{mA}, I_E=0$	(-)80			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	(-)60			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)1\text{mA}, I_C=0$	(-)5			V
Turn-on Time	t_{on}	at specified test circuit		0.1		μs
Storage Time	t_{stg}	"		0.5		μs
Fall Time	t_f	"		0.1		μs

*The 2SA1291/2SC3255 are classified by 1A h_{FE} as follows:

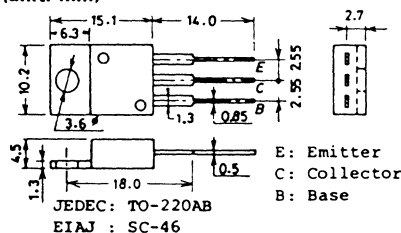
70	Q	140	100	R	200	140	S	280
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Switching Time Test Circuit

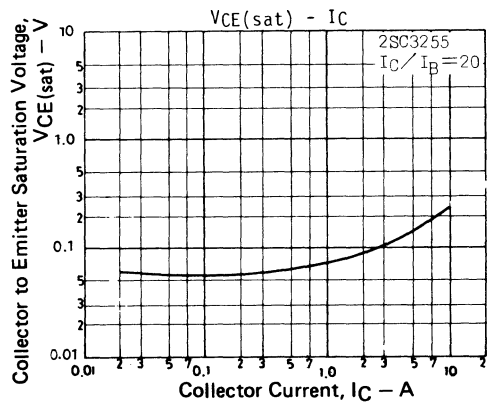
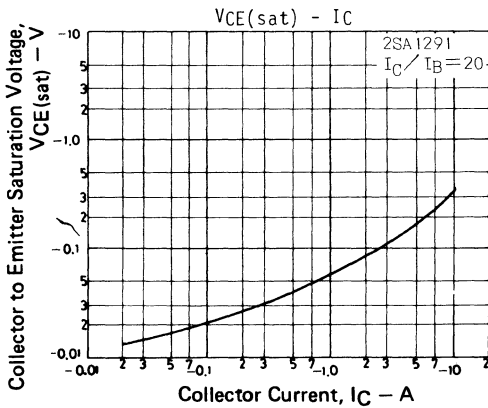
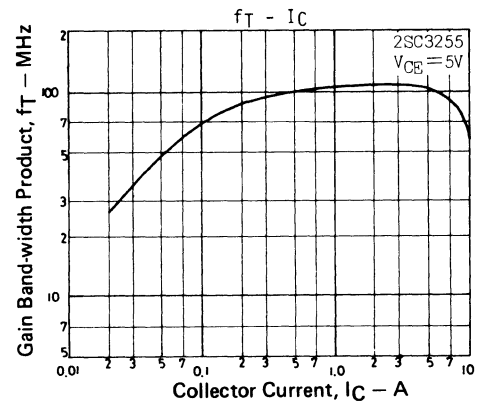
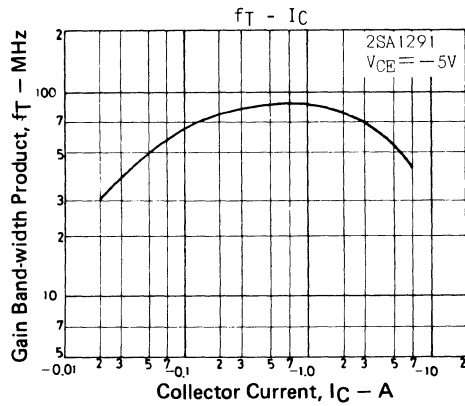
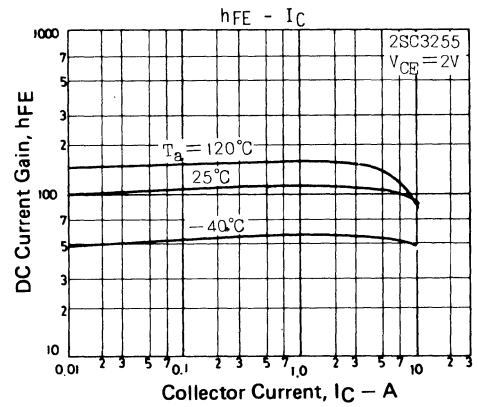
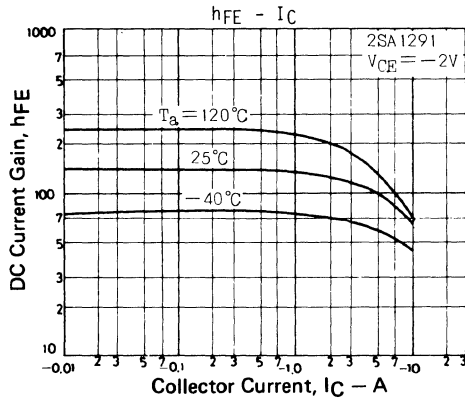
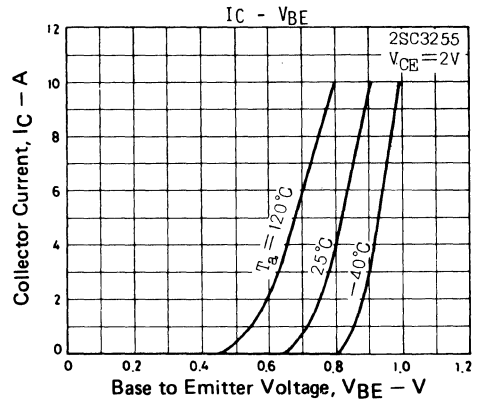
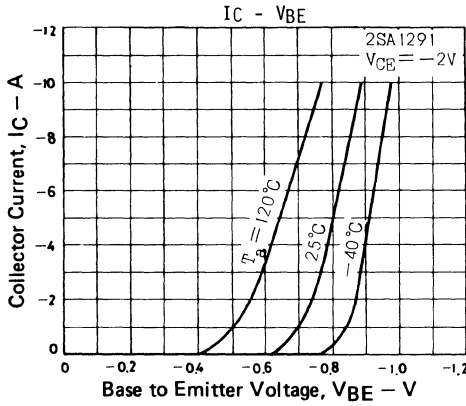


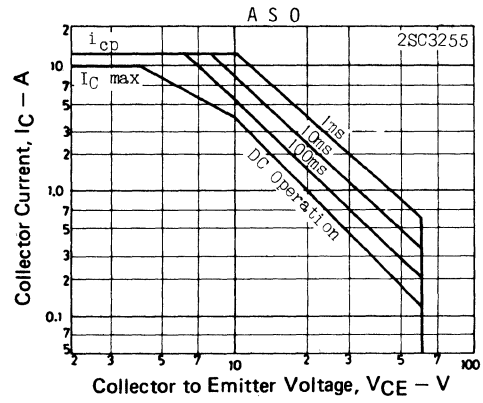
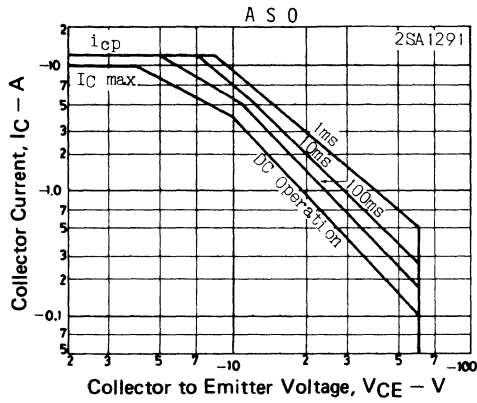
Case Outline 2010A

(unit: mm)



0183KI/TS/// No. 1201-1/3





2SC3277



2022

NPN Triple Diffused Planar
Silicon Transistor

High Speed Switching Applications

©1207

Features

- . High breakdown voltage, high current.
- . Wide ASO.
- . Fast switching speed.

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	500	V
Collector to Emitter Voltage	V_{CE0}	400	V
Emitter to Base Voltage	V_{EB0}	7	V
Collector Current	I_C	10	A
Peak Collector	i_{cp}	20	A
		Pulse, $PW \leq 300\mu\text{s}$, Duty Cycle $\leq 10\%$	
Collector Dissipation	P_C	90	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$
		$T_c=25^{\circ}\text{C}$	

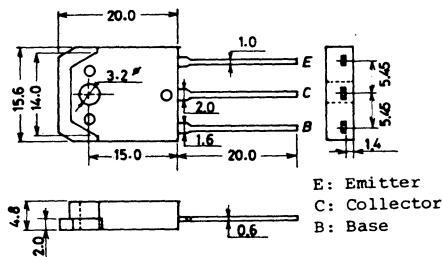
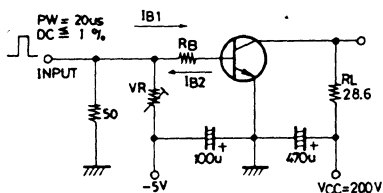
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=400\text{V}, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5\text{V}, I_C=0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5\text{V}, I_C=1.2\text{A}$	15			
	$h_{FE}(2)$	$V_{CE}=5\text{V}, I_C=6\text{A}$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=1.2\text{A}$		20		MHz
Output Capacitance	c_{ob}	$V_{CB}=10\text{V}, f=1\text{MHz}$		120		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=6\text{A}, I_B=1.2\text{A}$			1.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=6\text{A}, I_B=1.2\text{A}$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1\text{mA}, I_E=0$		500		V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=5\text{mA}, R_{BE}=\infty$		400		V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1\text{mA}, I_C=0$		7		V
C-E Sustain Voltage	$V_{CEO(sus)}$	$I_C=10\text{A}, I_B=2\text{A}, L=50\mu\text{H}$		400		V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C=10\text{A}, I_{B1}=2\text{A}, L=200\mu\text{H}$		400		V
	(1)	$I_{B2}=-2\text{A}, \text{clamped}$				
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C=2.5\text{A}, I_{B1}=0.5\text{A}, L=200\mu\text{H}, I_{B2}=-0.5\text{A}, \text{clamped}$		450		V
	(2)					

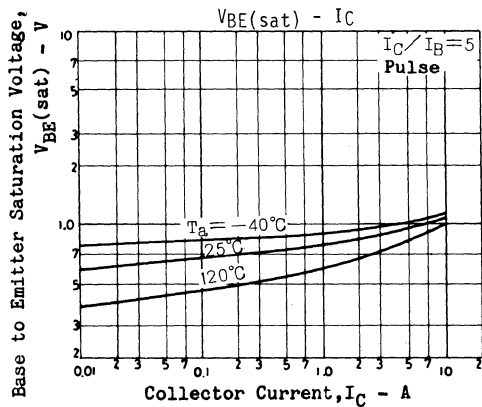
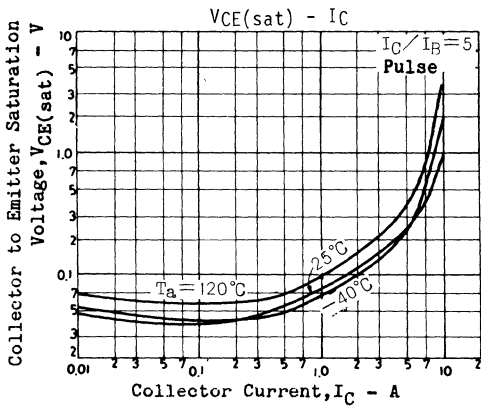
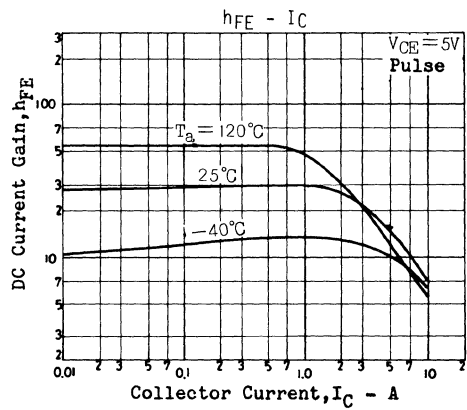
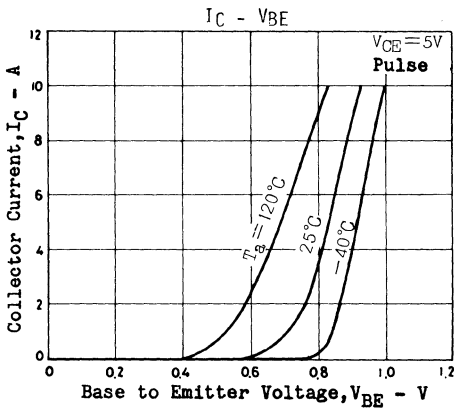
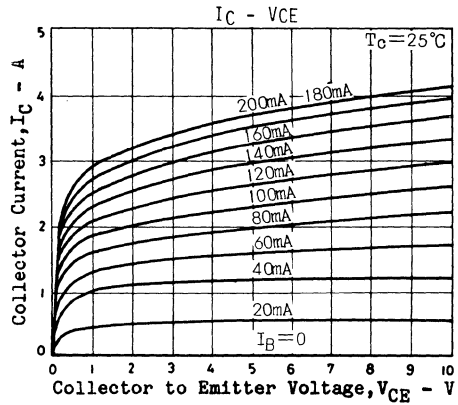
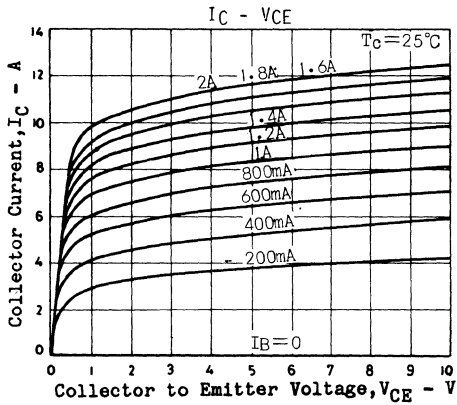
Case Outline 2022

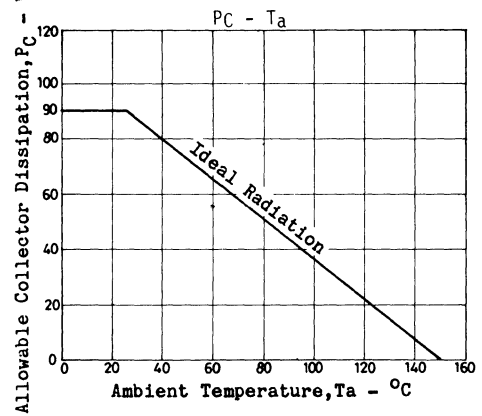
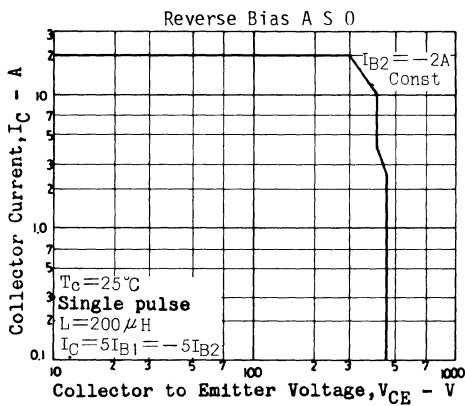
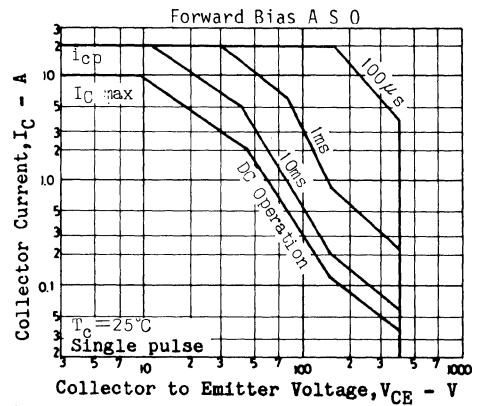
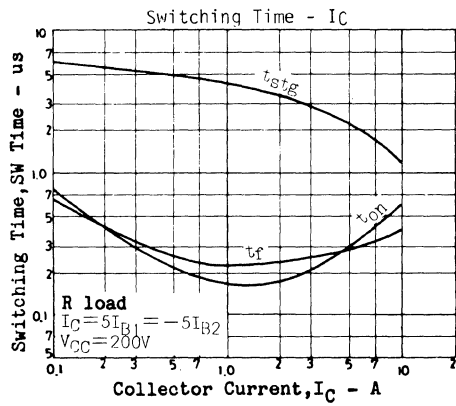
(unit:mm)

Switching Time Test Circuit

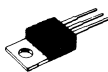


			min	typ	max	unit
Turn-ON Time	t_{on}	$I_C=7A, I_{B1}=1.4A, I_{B2}=-1.4A,$ $R_L=28.6\Omega, V_{CC}=200V$			1.0	us
Storage Time	t_{stg}	"			2.5	us
Fall Time	t_f	"			1.0	us





2SC3292



2010A

NPN Epitaxial Planar
Silicon Darlington Transistor

Driver Applications

©1332

Use:

- Especially suited for use in switching of L load motor driver, printer hammer driver, relay driver, etc.

Features:

- High DC current gain
- Large current capacity and wide ASO
- Contains 60 ± 10 V avalanche zener diode between collector and base
- Uniformity in collector-to-base breakdown voltage due to adoption of accurate impurity diffusion process
- 15 mJ reverse energy rating

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

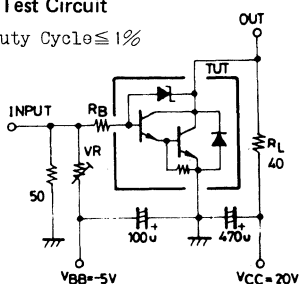
			unit	
Collector to base voltage	V_{CBO}	50*	V	*: Built-in
Collector to emitter voltage	V_{CEO}	50*	V	Zener Diode
Emitter to base voltage	V_{EBO}	6	V	(60 ± 10 V)
Collector current	I_C	1.2	A	
Peak collector current	i_{cp}	2.5	A	
Base current	I_B	0.25	A	
Collector dissipation	P_C	20	W	
Junction temperature	T_j	150	$^\circ\text{C}$	
Storage temperature	T_{stg}	$-55 \sim +150$	$^\circ\text{C}$	

Electrical Characteristics/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB}=40\text{ V}, I_E=0$			10	μA
Emitter cutoff current	I_{EBO}	$V_{EB}=5\text{ V}, I_C=0$			2	mA
DC current gain	h_{FE}	$V_{CE}=5\text{ V}, I_C=0.5\text{ A}$	1000	4000		
Gain bandwidth product	f_T	$V_{CE}=5\text{ V}, I_C=0.5\text{ A}$		180		MHz
C-E saturation voltage	$V_{CE(sat)}$	$I_C=0.5\text{ A}, I_B=2\text{ mA}$		1.0	1.5	V
B-E saturation voltage	$V_{BE(sat)}$	$I_C=0.5\text{ A}, I_B=2\text{ mA}$			2.0	V
C-B breakdown voltage	$V_{(BR)CBO}$	$I_C=0.1\text{ mA}, I_E=0$	50	60	70	V
C-E breakdown voltage	$V_{(BR)CEO}$	$I_C=1\text{ mA}, R_{BE}=\infty$	50	60	70	V
Unclamped inductive load energy	E_s/b	$L=100\text{ mH}, R_{BE}=100\Omega$	15			mJ
Turn-on time	t_{on}	$V_{CC}=20\text{ V}, I_C=0.5\text{ A}$		0.2		μs
Storage time	t_{stg}	$I_{B1}=-I_{B2}=2\text{ mA}$		2.2		μs
Fall time	t_f			0.4		μs

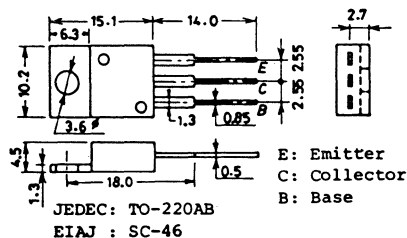
Switching Time Test Circuit

$PW=50\mu\text{s}$, Duty Cycle $\leq 1\%$



Case Outline 2010A

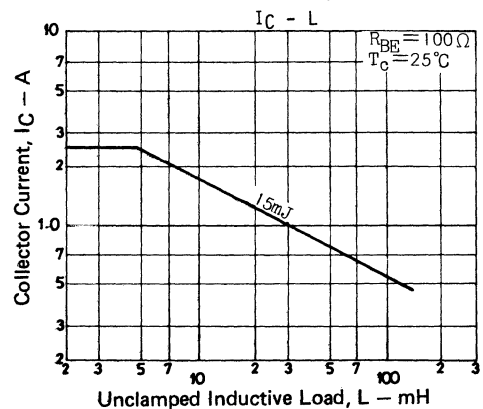
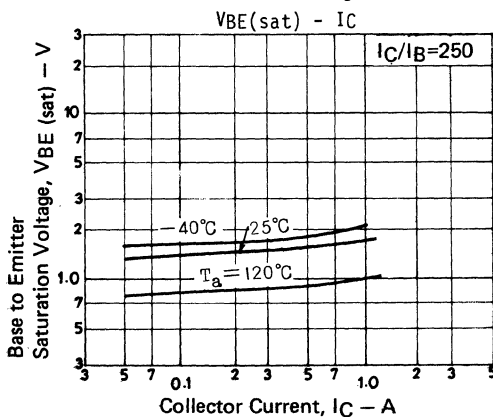
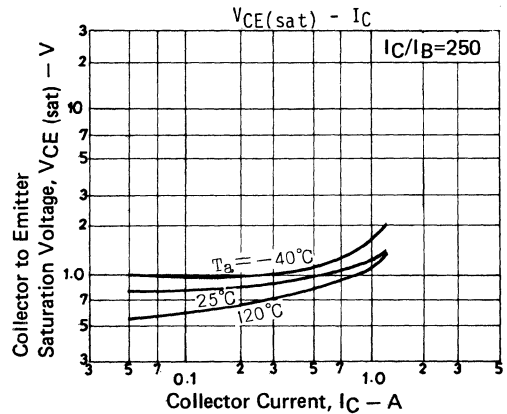
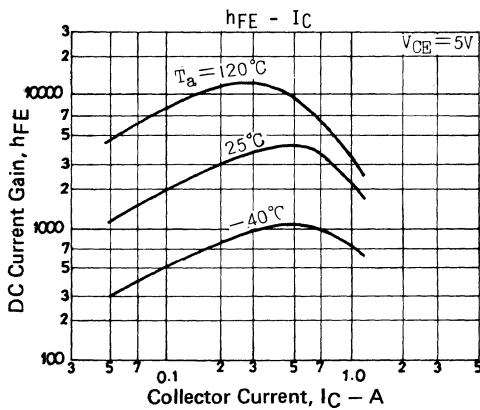
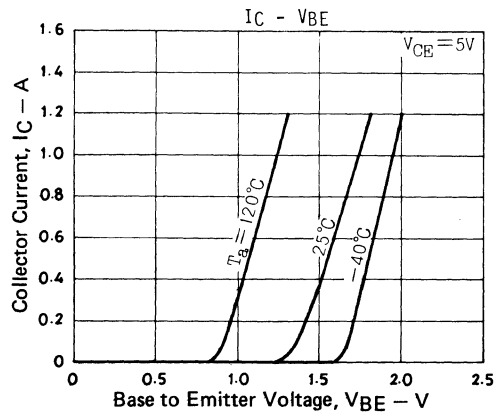
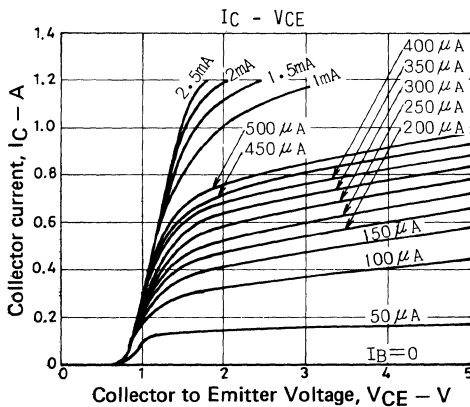
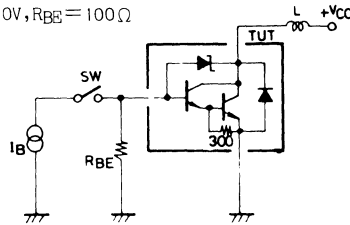
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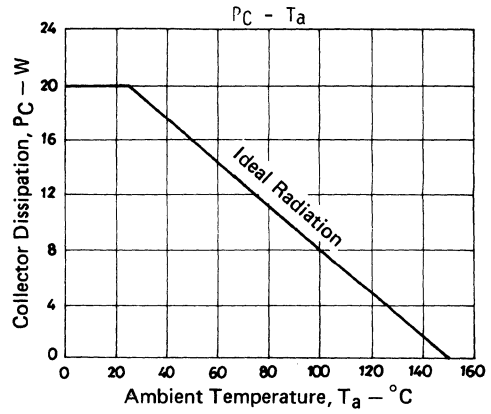
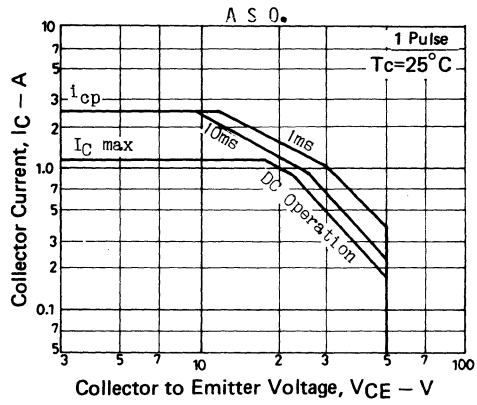


8253KI, TS#NO. 1332-1/3

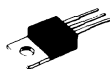
Es/b Test Circuit

$$V_{CC} = 20V, R_{BE} = 100\Omega$$





2SC3293



2010A

NPN Epitaxial Planar
Silicon Darlington Transistor

Driver Applications

©1333

Use:

- Especially suited for use in switching of L load motor driver, printer hammer driver, relay driver, etc.

Features:

- High DC current gain
- Large current capacity and wide ASO
- Contains 60 ± 10 V avalanche diode between collector and base
- Uniformity in collector-to-base breakdown voltage due to adoption of accurate impurity diffusion process
- 25 mJ reverse energy rating

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit	
Collector to base voltage	V_{CBO}	50*	V	*:Built-in
Collector to emitter voltage	V_{CEO}	50*	V	Zener Diode
Emitter to base voltage	V_{EBO}	6	V	(60 ± 10 V)
Collector current	I_C	2	A	
Peak collector current	i_{cp}	4	A	
Base current	I_B	0.4	A	
Collector dissipation	P_C	20	W	
Junction temperature	T_j	150	$^\circ\text{C}$	
Storage temperature	T_{stg}	$-55 \sim +150$	$^\circ\text{C}$	

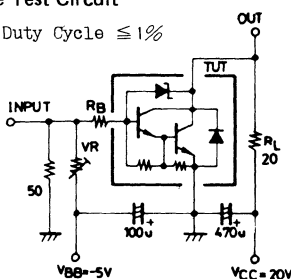
$T_c = 25^\circ\text{C}$

Electrical Characteristics/ $T_a = 25^\circ\text{C}$

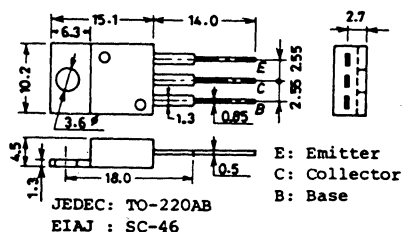
			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = 40$ V, $I_E = 0$			10	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = 5$ V, $I_C = 0$			2	mA
DC current gain	h_{FE}	$V_{CE} = 5$ V, $I_C = 1$ A	1000	4000		
Gain bandwidth product	f_T	$V_{CE} = 5$ V, $I_C = 1$ A		180		MHz
C-E saturation voltage	$V_{CE(sat)}$	$I_C = 1$ A, $I_B = 4$ mA		1.0	1.5	V
B-E saturation voltage	$V_{BE(sat)}$	$I_C = 1$ A, $I_B = 4$ mA			2.0	V
C-B breakdown voltage	$V_{(BR)CBO}$	$I_C = 0.1$ mA, $I_E = 0$	50	60	70	V
C-E breakdown voltage	$V_{(BR)CEO}$	$I_C = 1$ mA, $R_{BE} = \infty$	50	60	70	V
Unclamped inductive load energy	E_s/b	$L = 100$ mH, $R_{BE} = 100\Omega$	25			mJ
Turn-on time	t_{on}	$V_{CC} = 20$ V, $I_C = 1$ A		0.2		μs
Storage time	t_{stg}	$I_{B1} = -I_{B2} = 4$ mA		3.5		μs
Fall time	t_f	$I_{B1} = -I_{B2} = 4$ mA		0.5		μs

Switching Time Test Circuit

$PW = 50 \mu\text{s}$, Duty Cycle $\leq 1\%$

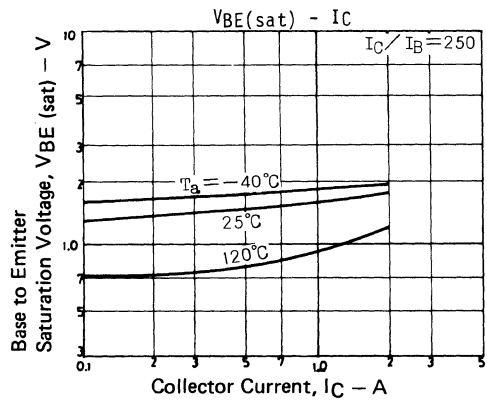
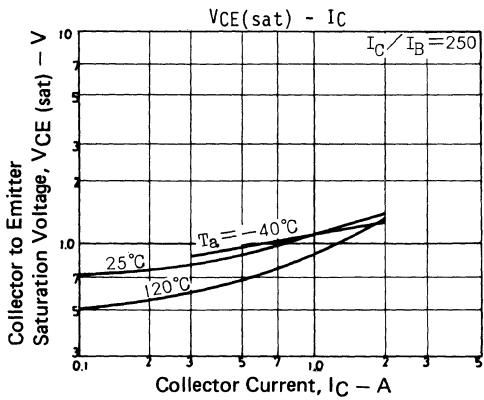
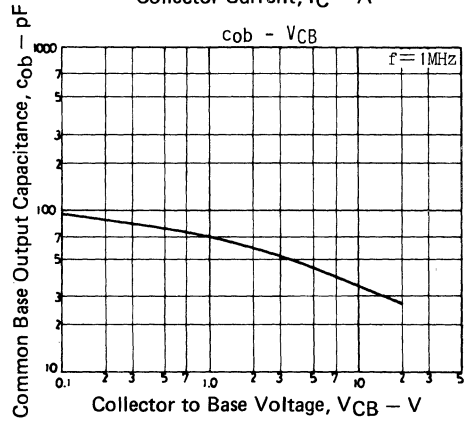
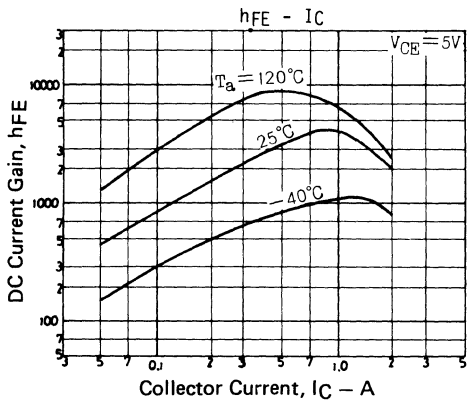
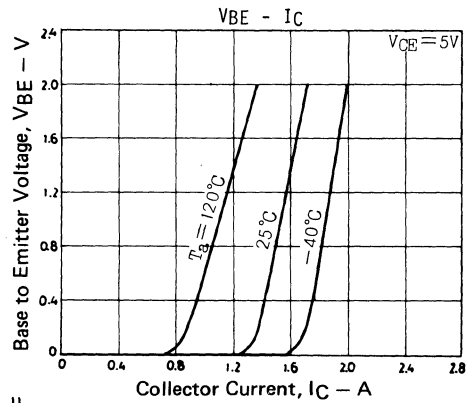
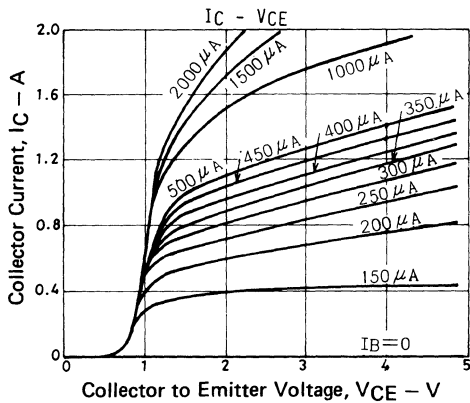
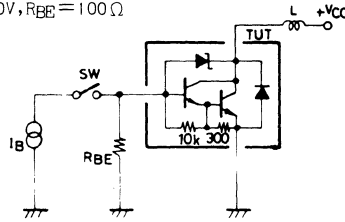


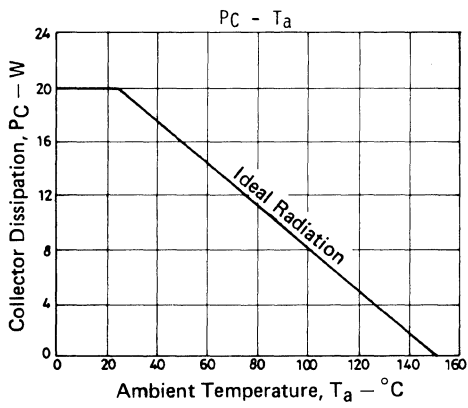
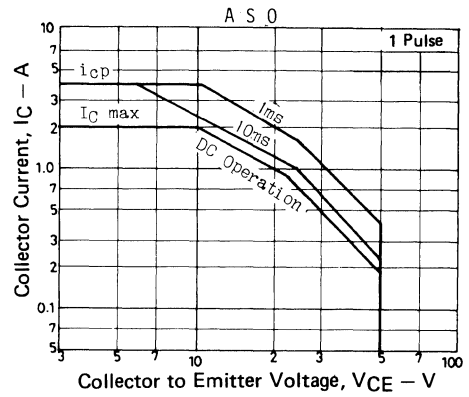
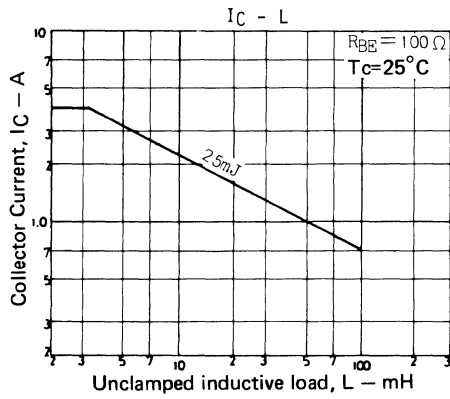
Case Outline 2010A (unit: mm)



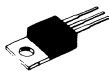
Es/b Test Circuit

$$V_{CC}=20V, R_{BE}=100\Omega$$





2SC3294



2010A

NPN Planar
Silicon Darlington Transistor

High Speed Driver Applications

©1422

Use

- Switching of L load (motor driver, printer hammer driver, relay driver)

Features

- High DC current gain.
- Large current capacity and wide ASO.
- Avalanche diode of $60 \pm 10V$ connected between collector and base.
- Uniformity in collector-to-base breakdown voltage due to accurate impurity diffusion process.
- Large L load handling capability.

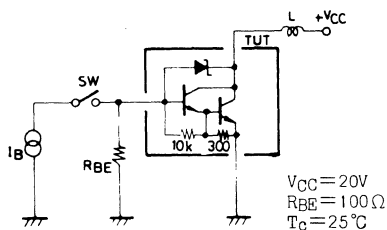
Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CB0}	50	V
Collector to Emitter Voltage	V_{CE0}	50	V
Emitter to Base Voltage	V_{EB0}	6	V
Collector Current	I_C	3	A
Peak Collector Current	i_{cp}	6	A
Base Current	I_B	0.6	A
Collector Dissipation	P_C	25	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

$T_C = 25^\circ C$

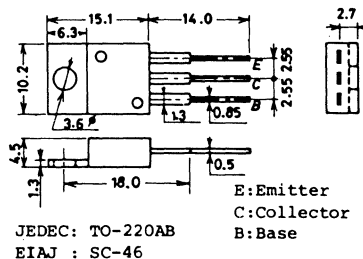
*: With zener diode ($60 \pm 10V$)

Es/b Test Circuit



Case Outline 2010A

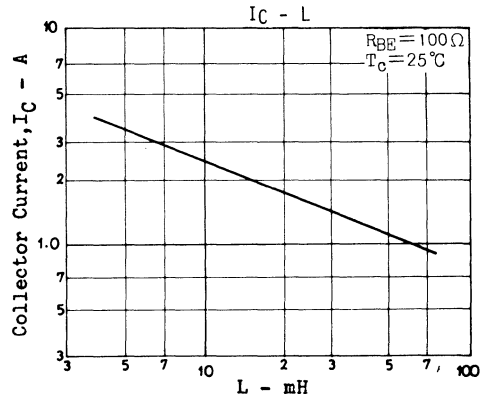
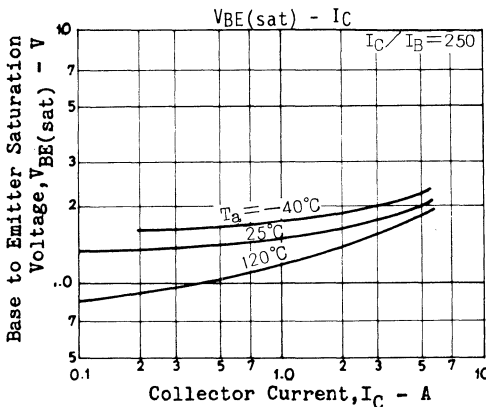
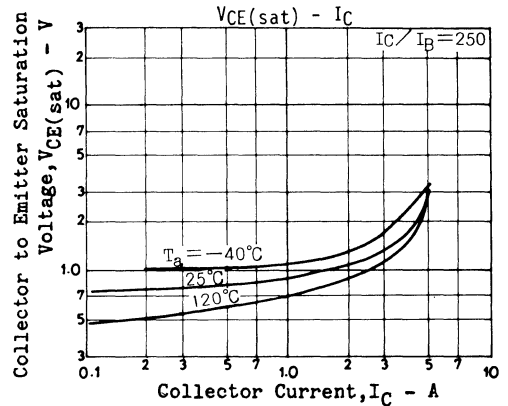
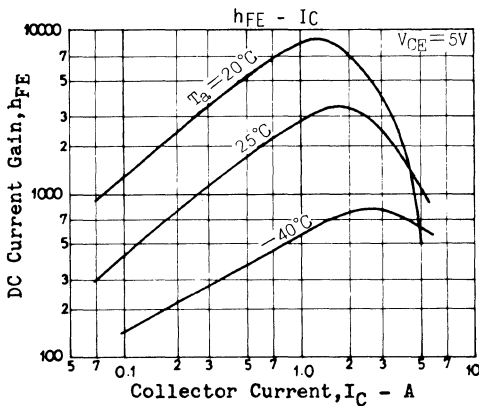
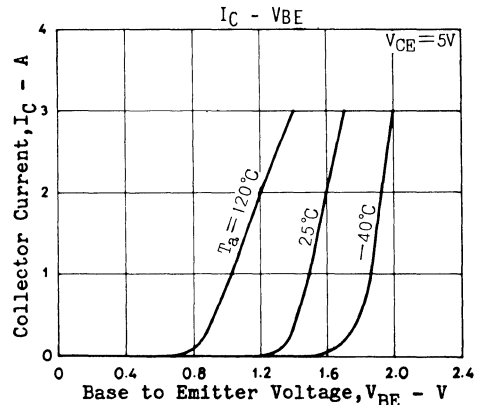
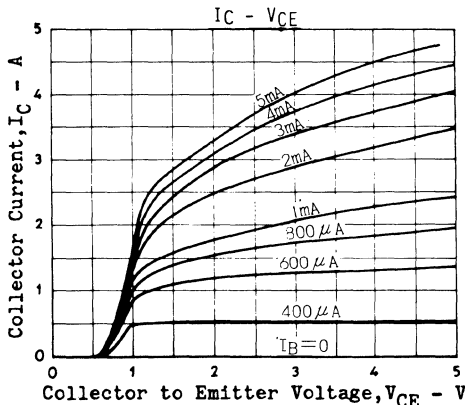
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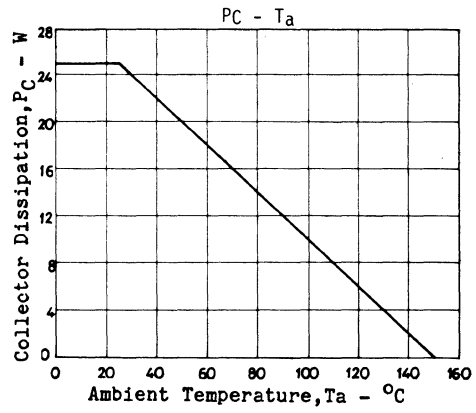
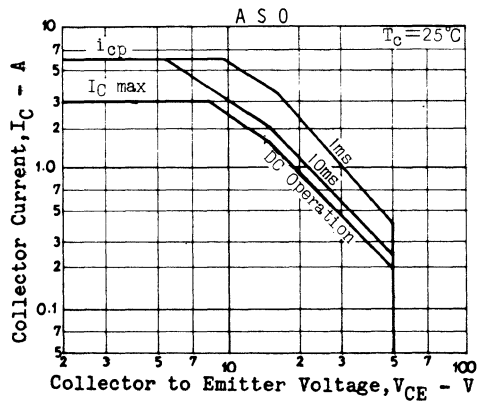


D174MY, TS No.1422-1/3

Electrical Characteristics at $T_a=25^\circ\text{C}$

		min	typ	max	unit
Collector Cutoff Current	I_{CBO}			10	μA
Emitter Cutoff Current	I_{EBO}			2	mA
DC Current Gain	h_{FE}	1000	4000		
Gain Bandwidth Product	f_T		180		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	1.0	1.5		V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$			2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	50	60	70	V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	50	60	70	V
L Load Handling Capability	$E_{S/b}$	30			mJ





2SC3330



2033

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1317

Low Frequency, General-Purpose Amp Applications

©1599

Use

- . Capable of being used in the low frequency to high frequency range.

Features

- . Large current capacity and wide ASO.

(): 2SA1317

Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CB0}	(-)60	V
Collector to Emitter Voltage	V_{CEO}	(-)50	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)200	mA
Peak Collector Current	i_{cp}	(-)400	mA
Collector Dissipation	P_C	300	mW
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

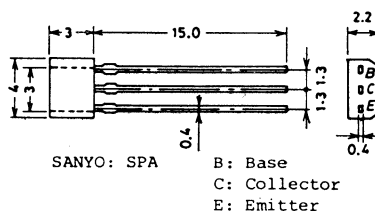
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40V, I_E=0$			(-)0.1	uA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5V, I_C=0$			(-)0.1	uA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=(-)6V, I_C=(-)1mA$	100*		800*	
			(100)		(560)	
	$h_{FE}(2)$	$V_{CE}=(-)6V, I_C=(-)0.1mA$	70			
Gain Bandwidth Product	f_T	$V_{CE}=(-)6V, I_C=(-)10mA$		200		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)6V, f=1MHz$		3.0		pF
				(4.0)		

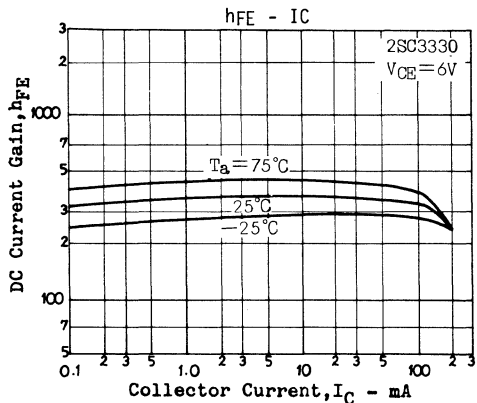
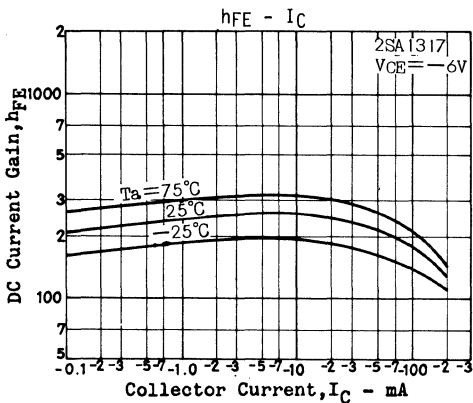
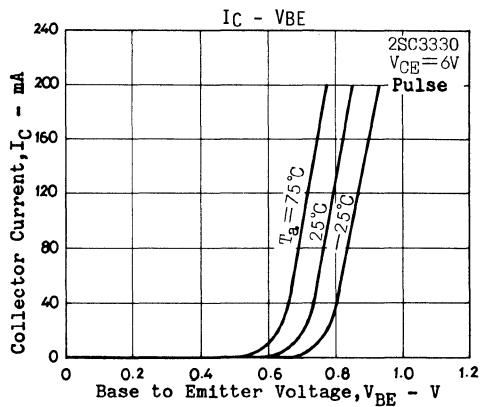
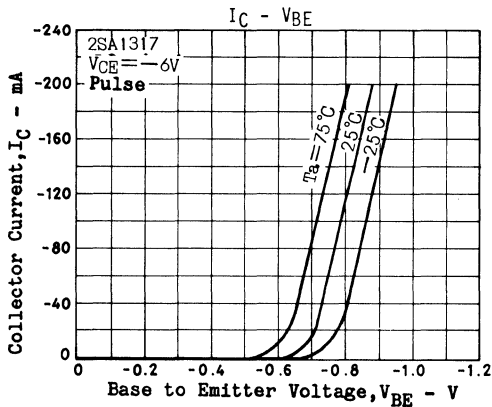
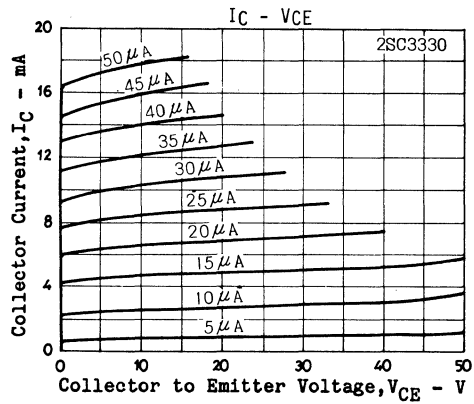
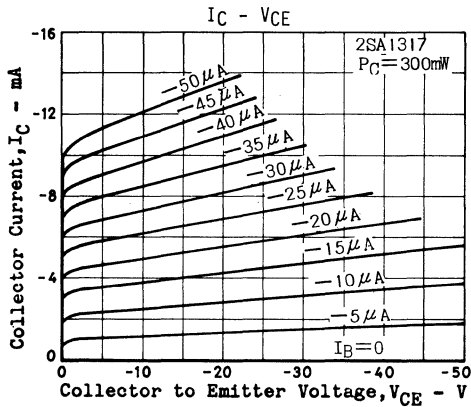
* The 2SA1317/2SC3330 are classified by 1mA h_{FE} as follows:

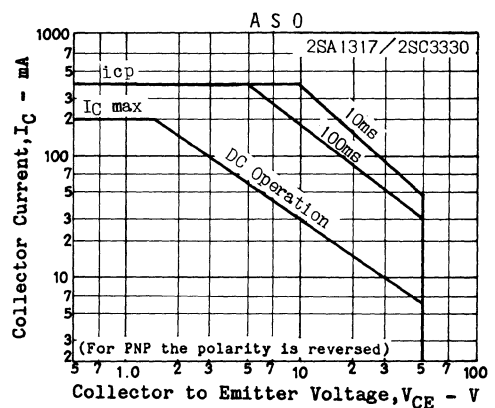
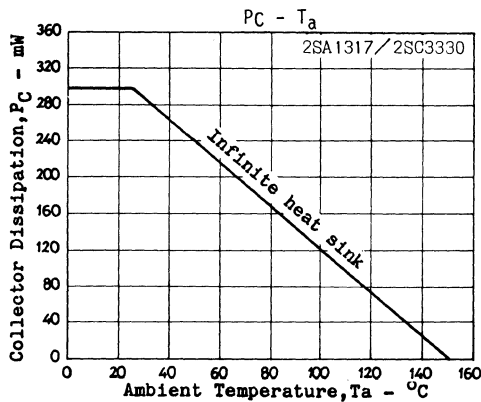
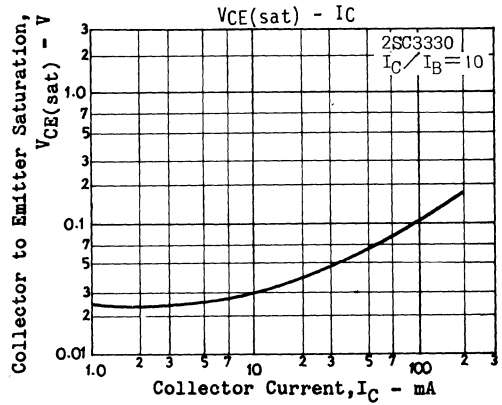
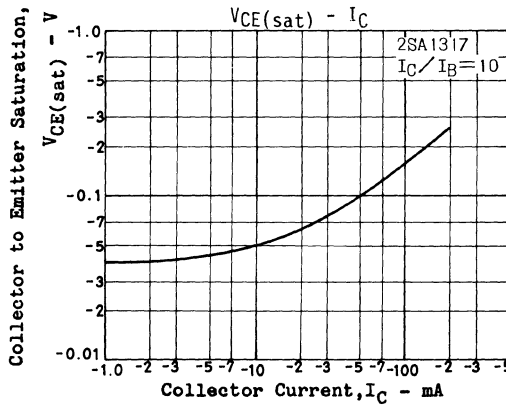
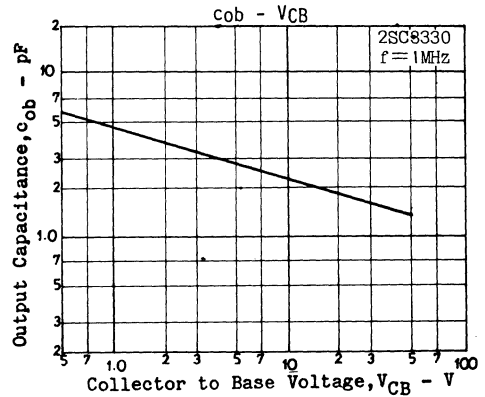
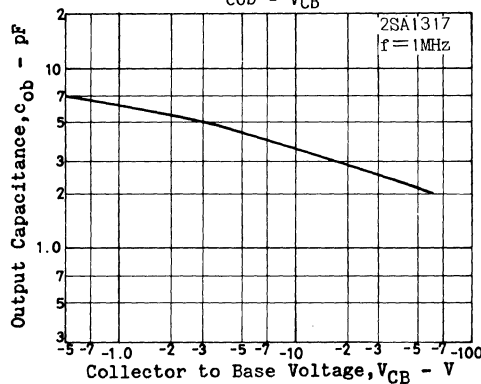
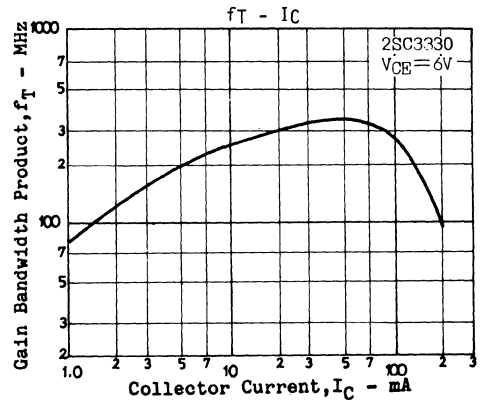
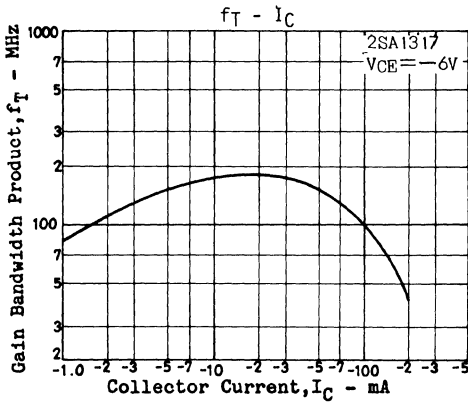
2SA1317	100	R	200	140	S	280	200	T	400	280	U	560	
2SC3330	100	R	200	140	S	280	200	T	400	280	U	560	400 V 800

Case Outline 2033 (unit:mm)



		min	typ	max	unit
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$			(-)0.3	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$			(-)1.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$			(-)60	V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$			(-)50	V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$			(-)6	V





2SC3331



2003A

NPN/PNP Epitaxial Planar
Silicon Transistors**2SA1318**

Low Frequency, General-Purpose Amp Applications

©1600

Use

- Capable of being used in the low frequency to high frequency range.

Features

- Large current capacity and wide ASO.

(): 2SA1318

Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CB0}	(-)60	V
Collector to Emitter Voltage	V_{CEO}	(-)50	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)200	mA
Peak Collector Current	i_{cp}	(-)400	mA
Collector Dissipation	P_C	500	mW
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

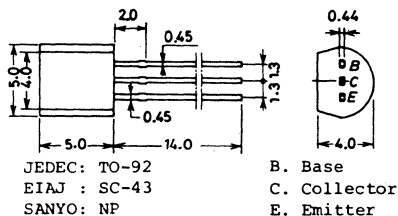
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)40V, I_E=0$		(-)0.1		uA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)5V, I_C=0$		(-)0.1		uA
DC Current Gain	$h_{FE(1)}^*$	$V_{CE}=(-)6V, I_C=(-)1mA$	100*		800*	
			(100)		(560)	
	$h_{FE(2)}$	$V_{CE}=(-)6V, I_C=(-)0.1mA$	70			
Gain Bandwidth Product	f_T	$V_{CE}=(-)6V, I_C=(-)10mA$		200		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)6V, f=1MHz$		3.0		pF
				(4.5)		

* The 2SA1318/2SC3331 are classified by 1mA h_{FE} as follows:

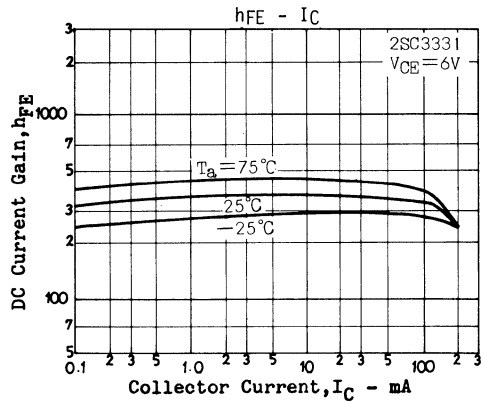
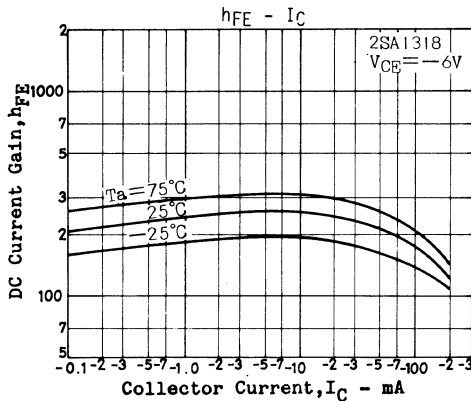
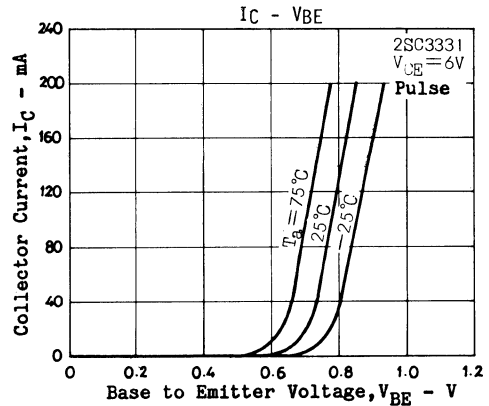
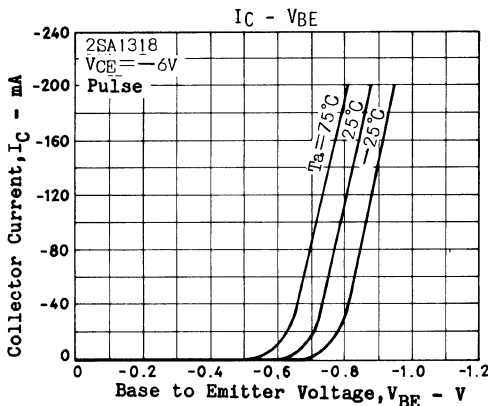
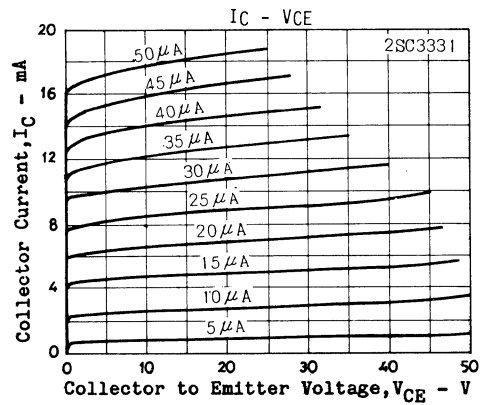
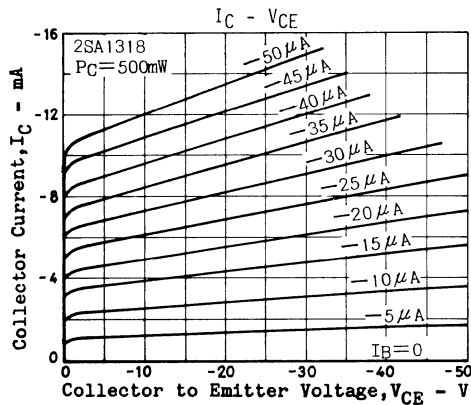
2SA1318	100	R	200	140	S	280	200	T	400	280	U	560			
2SC3331	100	R	200	140	S	280	200	T	400	280	U	560	400	V	800

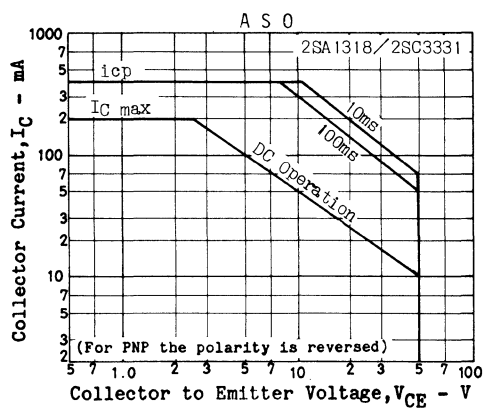
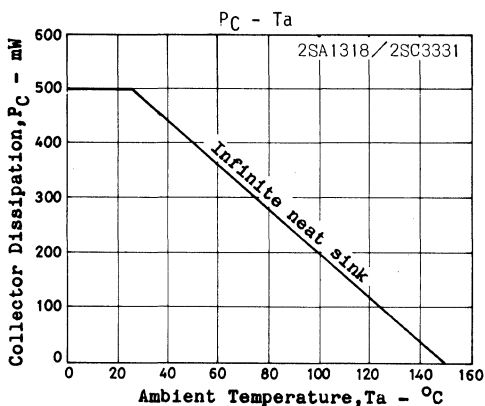
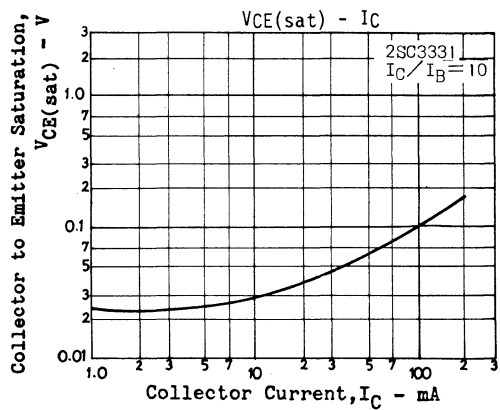
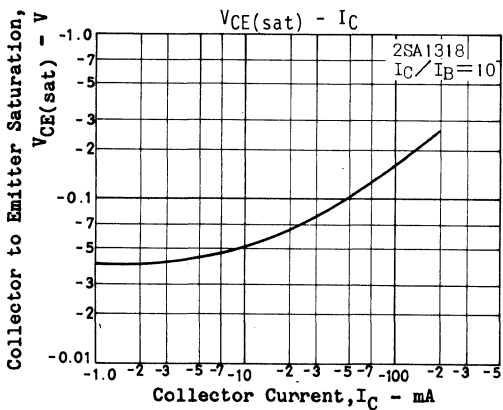
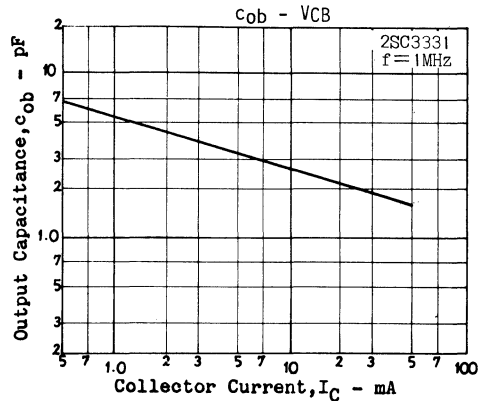
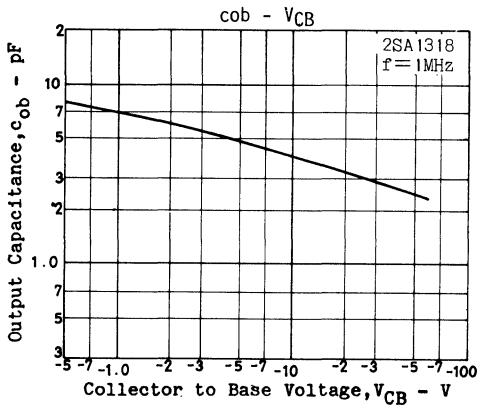
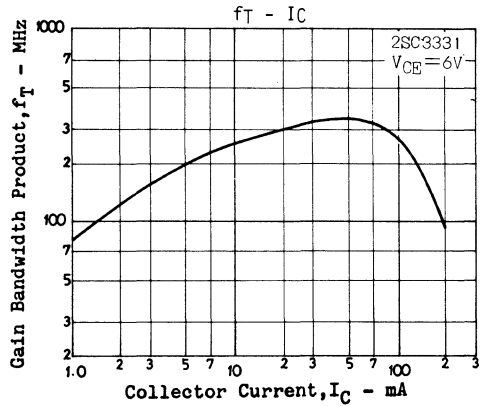
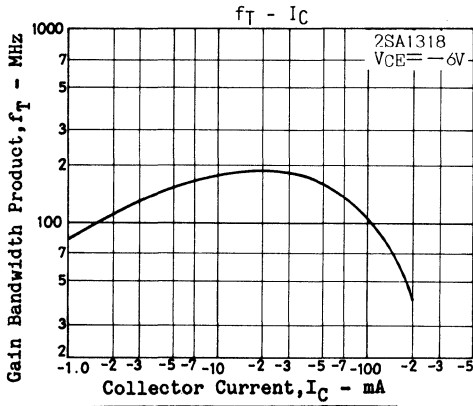
Case Outline 2003A (unit:mm)



D054MY, TS No.1600-1/3

			min	typ	max	unit
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)100mA, I_E=(-)10mA$			$(-)0.3$	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)100mA, I_E=(-)10mA$			$(-)1.0$	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10uA, I_E=0$	$(-)60$			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	$(-)50$			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10uA, I_C=0$	$(-)6$			V





2SC3332



2003A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1319

High Voltage Switching Applications

©1334A

Features

- High breakdown voltage.
- Excellent h_{FE} linearity.
- Wide ASO and highly resistant to breakdown.
- Adoption of MBIT process.

(): 2SA1319

Absolute maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)180	V
Collector to Emitter Voltage	V_{CEO}	(-)160	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)0.7	A
Peak Collector Current	i_{cp}	(-)1.5	A
Collector Dissipation	P_C	700	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

Electrical Characteristics/ $T_a=25^\circ\text{C}$

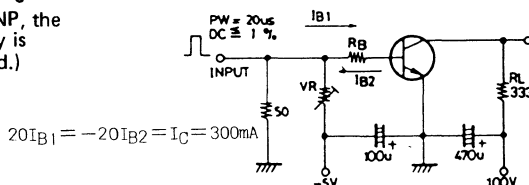
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)120\text{V}, I_E=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=(-)5\text{V}, I_C=(-)100\text{mA}$	100		400	
	$h_{FE}(2)$	$V_{CE}=(-)5\text{V}, I_C=(-)10\text{mA}$	80			
Gain Band-width Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		120		MHz
Common Base Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}$		(11)8		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)250\text{mA}, I_B=(-)25\text{mA}$		0.12	0.4	V
				(0.20)	(0.5)	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)250\text{mA}, I_B=(-)25\text{mA}$		(-)0.85	(-)1.2	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)180			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	(-)160			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$	(-)6			V
Turn-on Time	t_{on}	At specified test circuit	(60)50			ns
Storage Time	t_{stg}	"	(900)1000			ns
Fall Time	t_f	"	(60)60			ns

*: The 2SA1319/2SC3332 are classified by 100mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400
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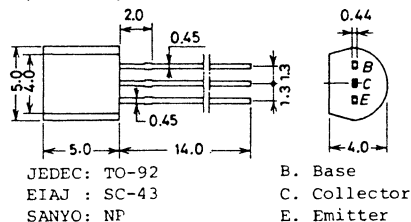
Switching Time Test Circuit

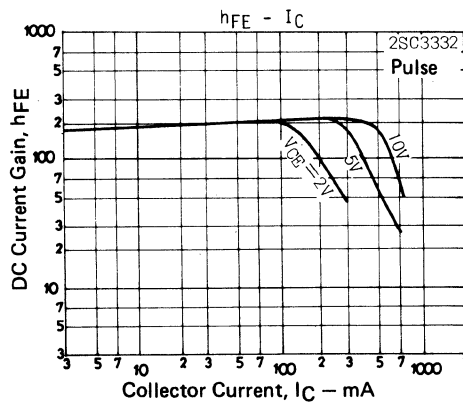
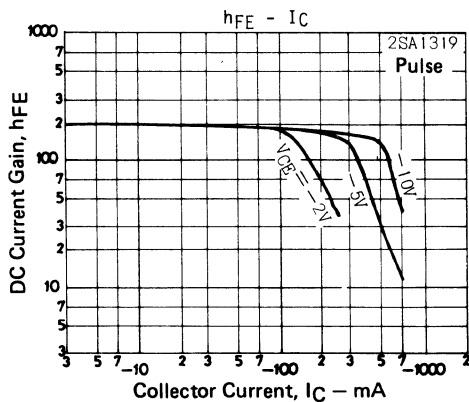
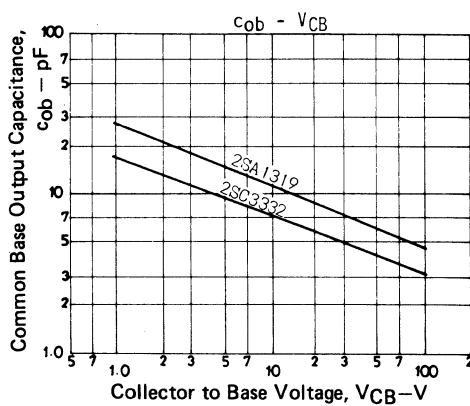
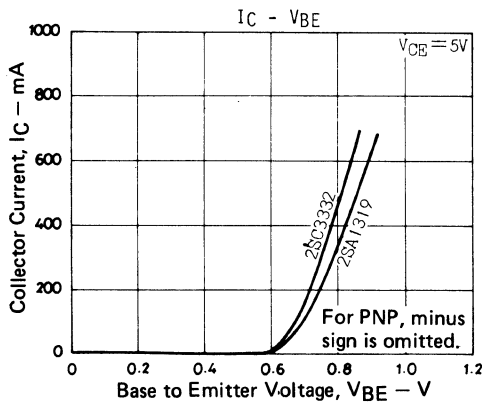
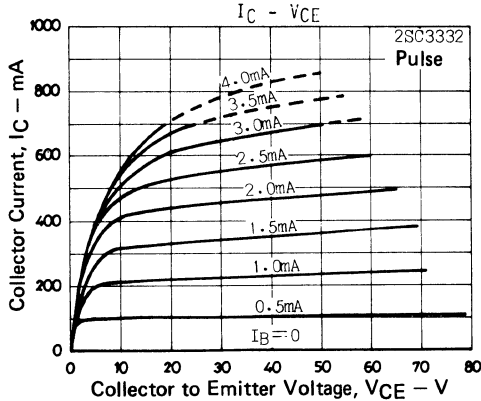
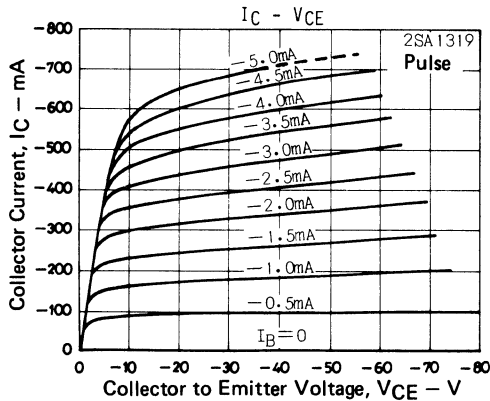
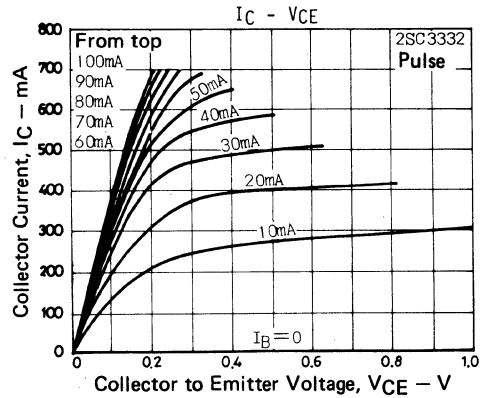
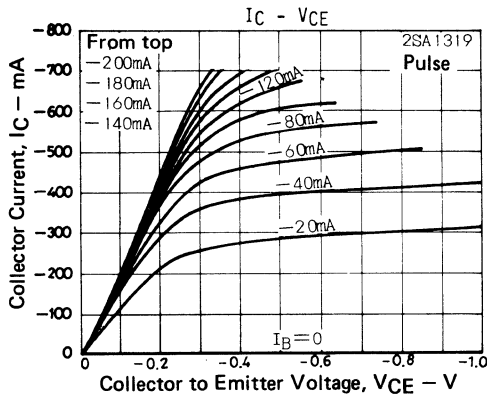
(For PNP, the polarity is reversed.)

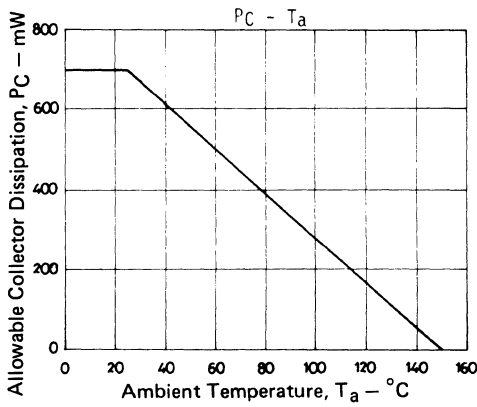
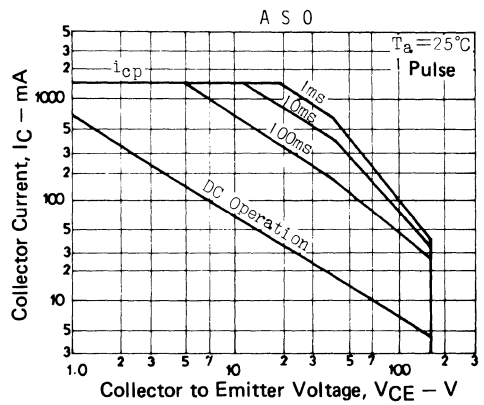
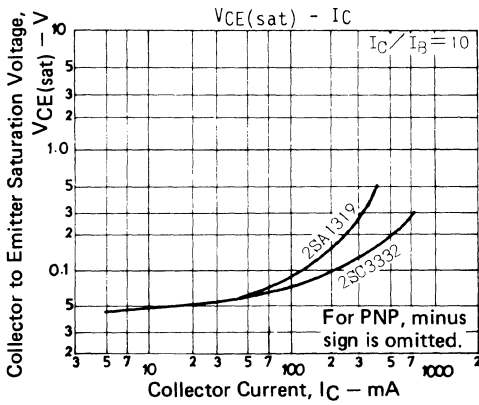
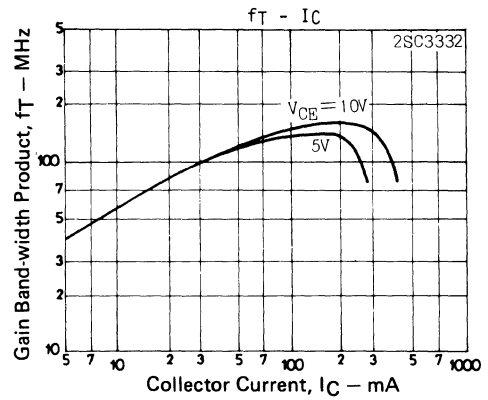
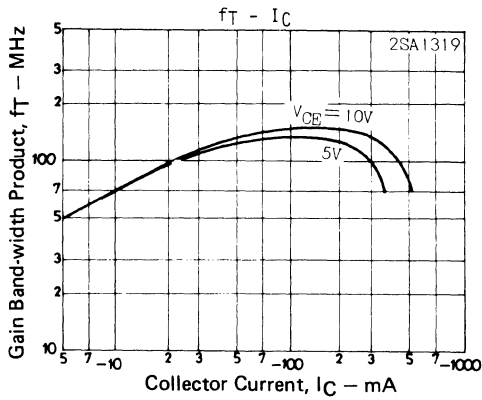


Case Outline 2003A

(unit: mm)







High Speed Switching Applications

©1342

Features

- High switching speed.
- High breakdown voltage.
- Very small-sized package permitting sets to be made small-sized and slim.

Applications

- High-speed switching applications.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	60	V
Collector to Emitter Voltage	V_{CE0}	50	V
Emitter to Base Voltage	V_{EB0}	5	V
Collector Current	I_C	150	mA
Peak Collector Current	i_{cp}	400	mA
Collector Dissipation	P_C	150	mW
Junction Temperature	T_j	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +125	$^\circ\text{C}$

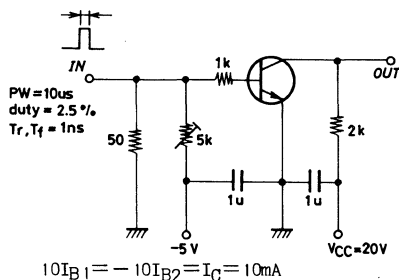
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=40\text{V}, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4\text{V}, I_C=0$			0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=6\text{V}, I_C=1\text{mA}$	90*		400*	
Gain Bandwidth Product	f_T	$V_{CE}=6\text{V}, I_C=1\text{mA}$		100		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=10\text{mA}, I_B=1\text{mA}$		0.1	0.4	V
B-E Breakdown Voltage	$V_{BE(sat)}$	$I_C=10\text{mA}, I_B=1\text{mA}$		0.75	1.1	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu\text{A}, I_E=0$	60			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1\text{mA}, R_{BE}=\infty$	50			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu\text{A}, I_C=0$	5			V
Delay Time	t_d	At test circuit		40		ns
Relay Time	t_r	"		80		ns
Storage Time	t_{stg}	"		230		ns
Fall Time	t_f	"		160		ns

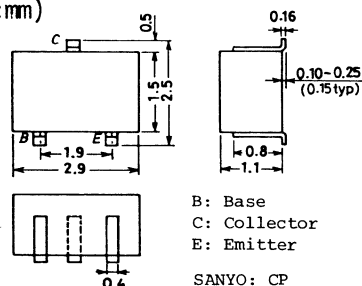
*: The 2SC3361 is classified by $1\text{mA } h_{FE}$ as follows :

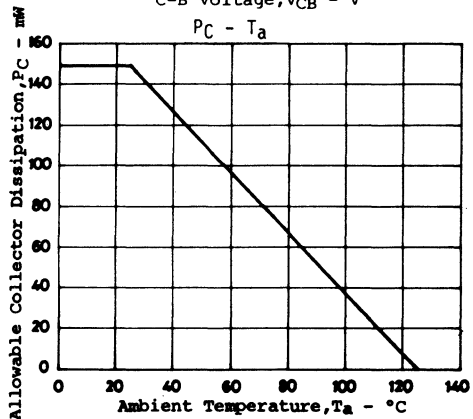
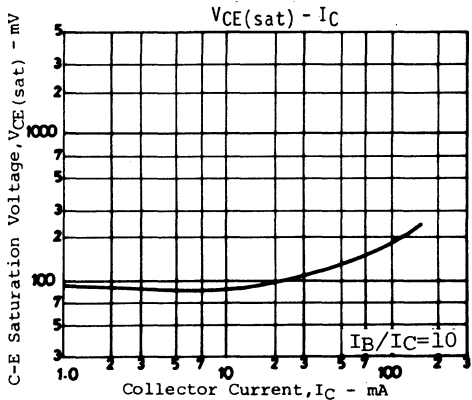
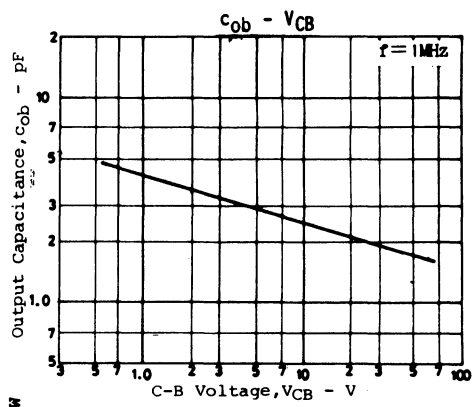
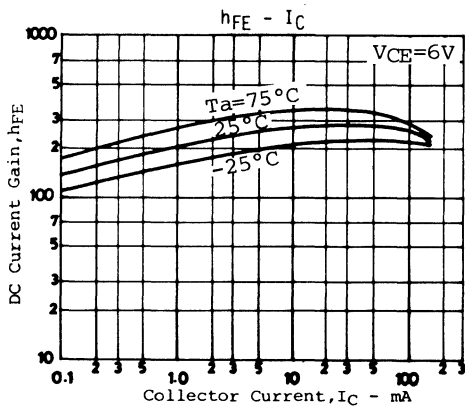
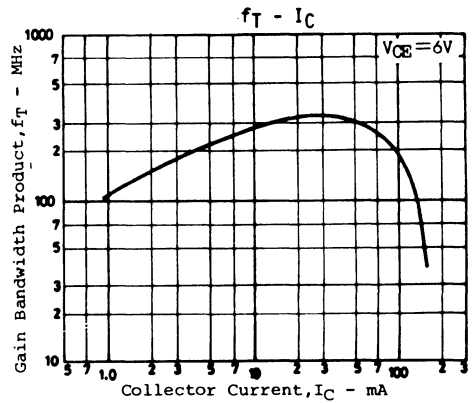
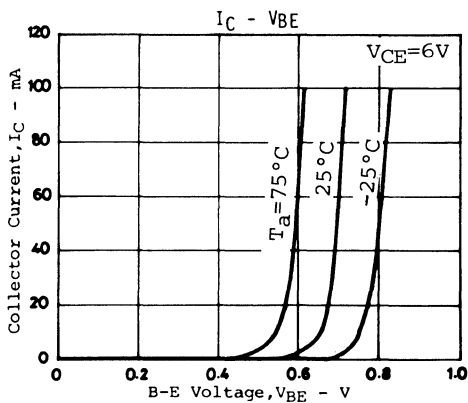
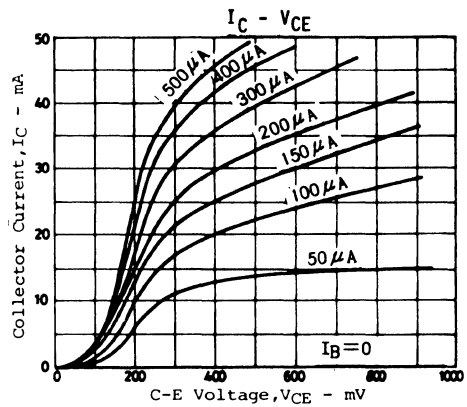
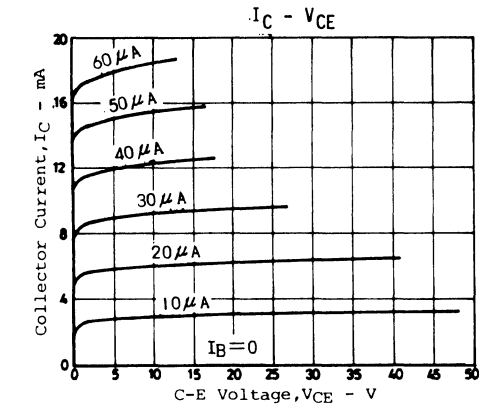
90	S4	180	135	S5	270	200	S6	400
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Switching Time Test Circuit



Case Outline 2018 (unit:mm)





2SC3382



2003A

NPN Epitaxial Planar
Silicon Transistor

Low Frequency, Low Noise Amp Applications

©1360A

Features

- * Adoption of FBET process
- * Low Noise
- * Small input/output capacitance

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	60	V
Collector to Emitter Voltage	V_{CE0}	50	V
Emitter to Base Voltage	V_{EB0}	6	V
Collector Current	I_C	200	mA
Peak Collector Current	i_{cp}	400	mA
Allowable Power Dissipation	P_C	400	mW
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

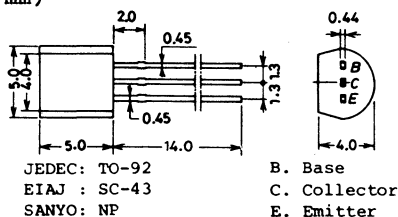
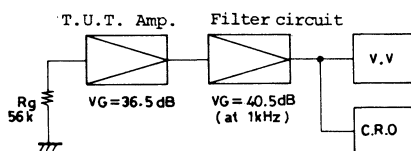
			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=40\text{V}, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=5\text{V}, I_C=0$			0.1	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=6\text{V}, I_C=1\text{mA}$	100*		560*	
	$h_{FE}(2)$	$V_{CE}=6\text{V}, I_C=0.1\text{mA}$	70			
Gain Bandwidth Product	f_T	$V_{CE}=6\text{V}, I_C=10\text{mA}$		250		MHz
Output Capacitance	c_{ob}	$V_{CB}=6\text{V}, f=1\text{MHz}$		2.7		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=100\text{mA}, I_B=10\text{mA}$			0.3	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=100\text{mA}, I_B=10\text{mA}$			1.0	V
C-B Breakdown Voltage	$V_{(BR)CB0}$	$I_C=10\mu\text{A}, I_E=0$	60			V
C-E Breakdown Voltage	$V_{(BR)CE0}$	$I_C=1\text{mA}, R_{BE}=\infty$	50			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu\text{A}, I_C=0$	6			V
Noise Level	$V_{NO(\text{average})}$	at test circuit. $V_{CC}=30\text{V}, I_C=1\text{mA},$ $R_g=56\text{k}\Omega, V_G=77\text{dB}$ (at=1kHz)			40	mV
Noise Peak Level	$V_{NO(\text{peak})}$	" "			280	mV

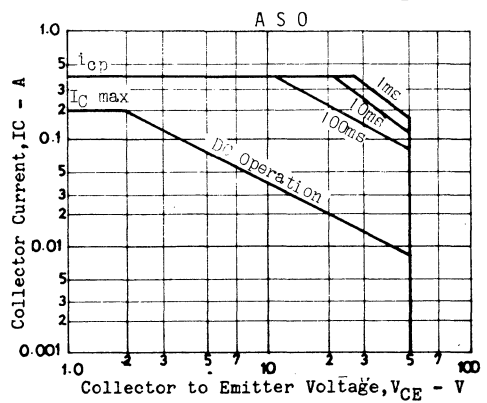
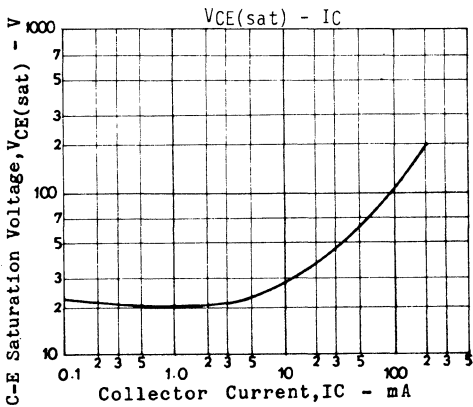
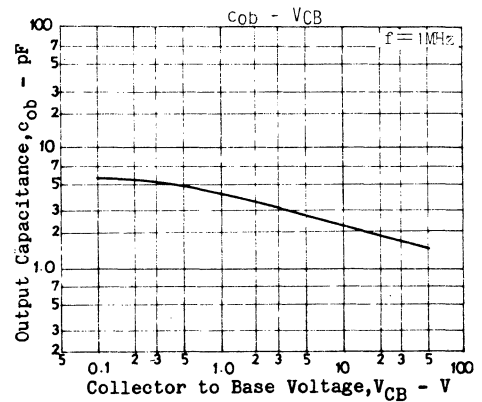
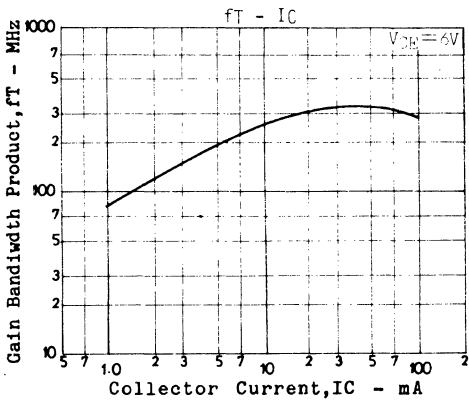
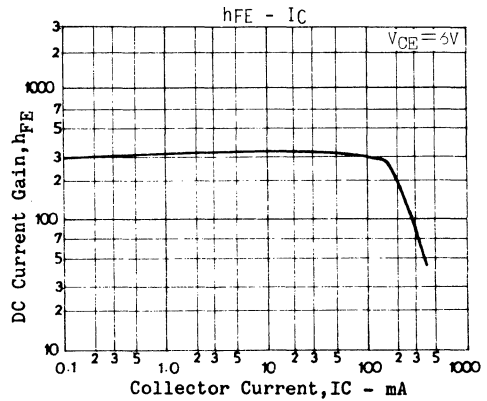
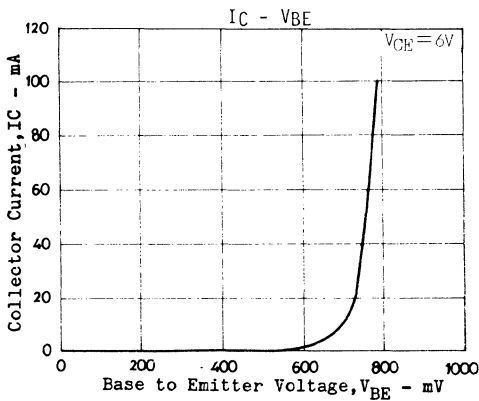
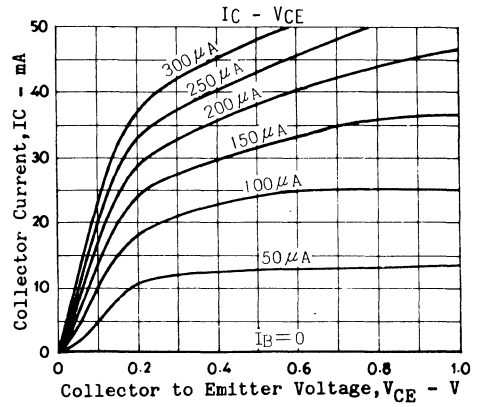
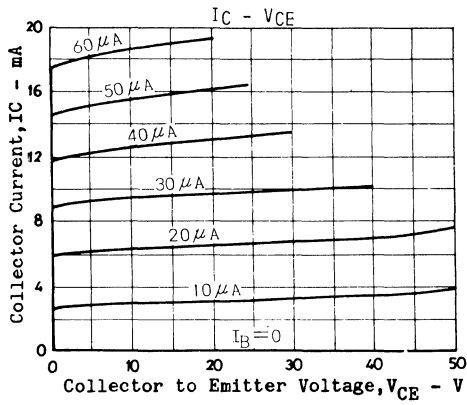
* The 2SC3382 is classified by 1mA h_{FE} as follows :

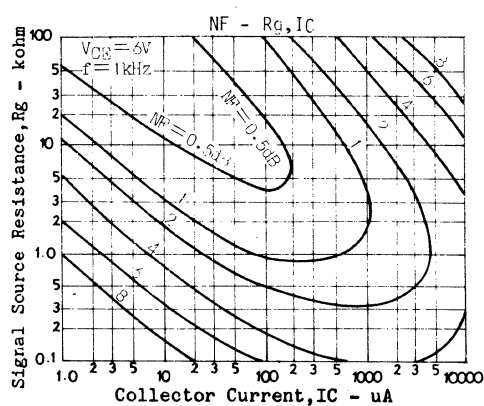
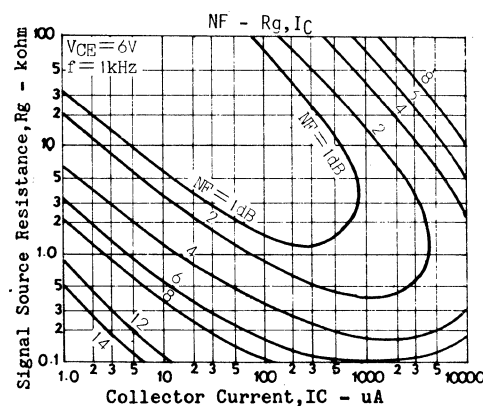
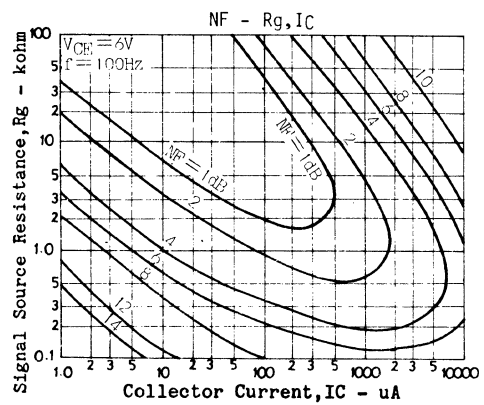
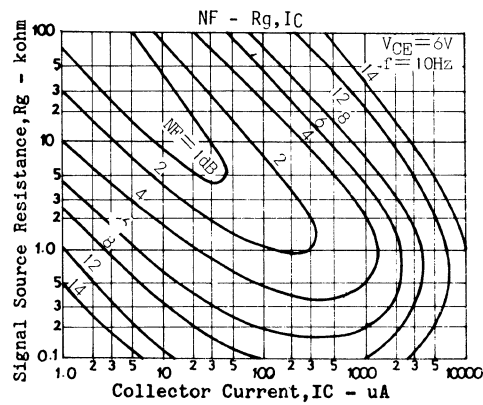
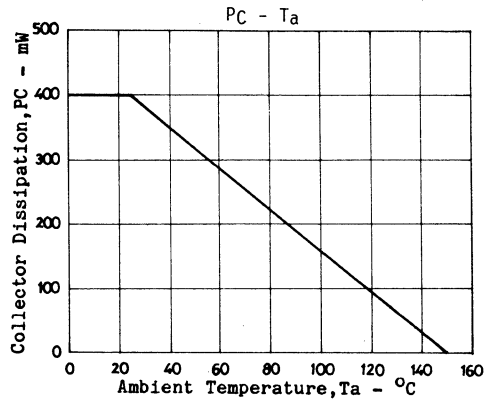
100	R	200	140	S	280	200	T	400	280	U	560
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Case Outline 2003A (unit:mm)

Noise Test Circuit







2SC3383



2003A

NPN Epitaxial Planar
Silicon Transistor

Low Frequency, General-Purpose Amp Applications

©1361

Features

- * Adoption of FBET process
- * Small input/output capacitance

Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CB0}	60	V
Collector to Emitter Voltage	V_{CE0}	50	V
Emitter to Base Voltage	V_{EB0}	6	V
Collector Current	I_C	200	mA
Peak Collector Current	i_{cp}	400	mA
Allowable Power Dissipation	P_C	500	mW
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

Electrical Characteristics at Ta=25°C

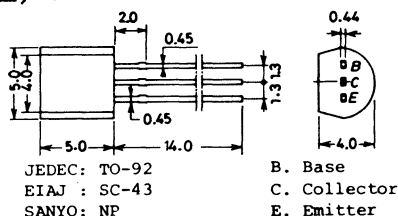
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=40V, I_E=0$			0.1	uA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			0.1	uA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=6V, I_C=1mA$	100*		560*	
	$h_{FE}(2)$	$V_{CE}=6V, I_C=0.1mA$	70			
Gain Bandwidth Product	f_T	$V_{CE}=6V, I_C=10mA$		250		MHz
Output Capacitance	c_{ob}	$V_{CB}=6V, f=1MHz$		2.7		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=100mA, I_B=10mA$			0.3	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=100mA, I_B=10mA$			1.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10uA, I_E=0$	60			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, R_{BE}=\infty$	50			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10uA, I_C=0$	6			V

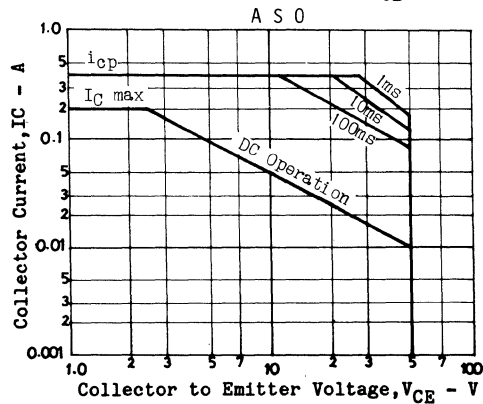
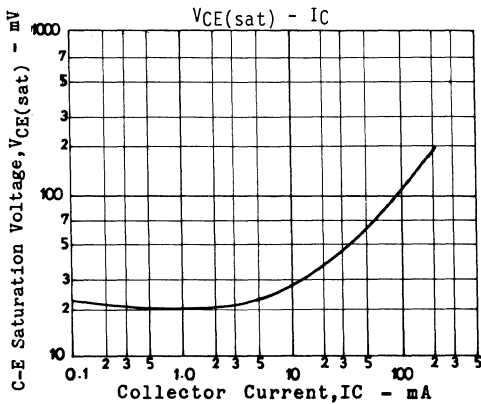
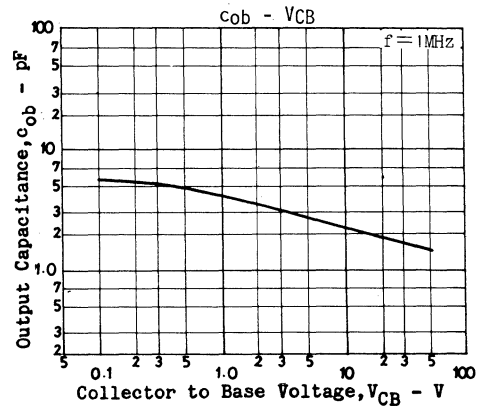
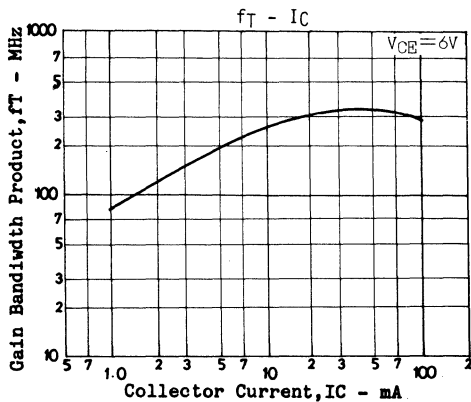
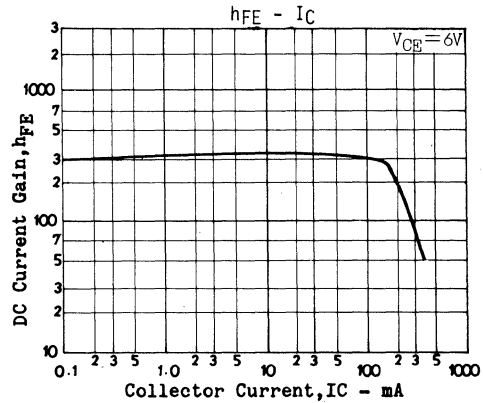
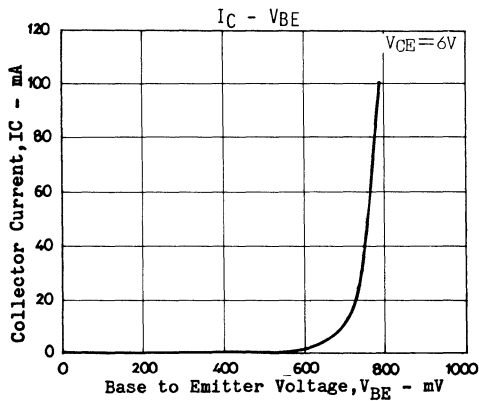
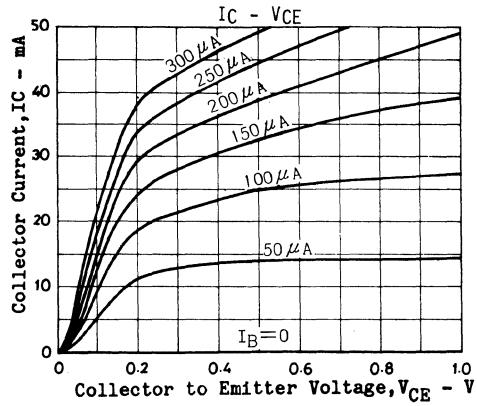
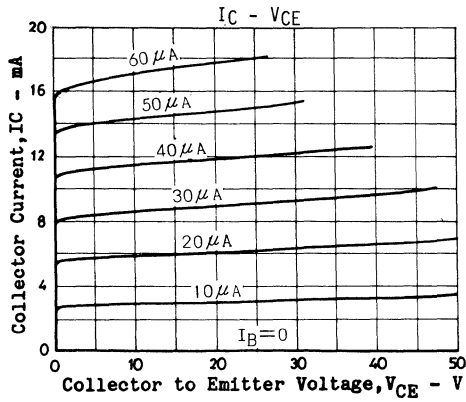
* The 2SC3382 is classified by 1mA h_{FE} as follows :

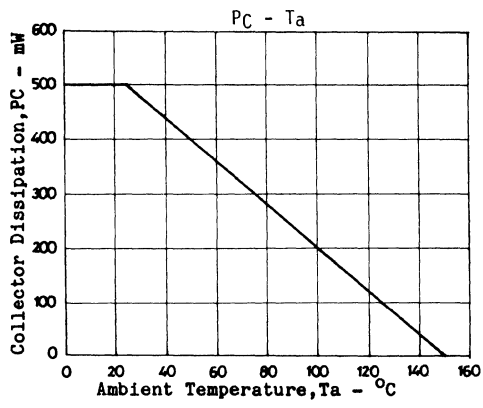
100	R	200	140	S	280	200	T	400	280	U	560
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Case Outline 2003A

(unit:mm)







2SC3392

2018

NPN/PNP Epitaxial Planar
Silicon Transistors**2SA1338**

High Speed Switching Applications

©1421

Features

- Adoption of FBET process
 - High breakdown voltage: $V_{CE0}=(-)50V$
 - Large current capacity and high f_T
 - Very small-sized package permitting sets to be small-sized, slim
- (): 2SA1338

Absolute Maximum Ratings at $T_a=25^{\circ}C$

			unit
Collector to Base Voltage	V_{CB0}	$(-)60$	V
Collector to Emitter Voltage	V_{CE0}	$(-)50$	V
Emitter to Base Voltage	V_{EB0}	$(-)5$	V
Collector Current	I_C	$(-)500$	mA
Peak Collector Current	i_{cp}	$(-)800$	mA
Collector Dissipation	P_C	200	mW
Junction Temperature	T_j	150	$^{\circ}C$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}C$

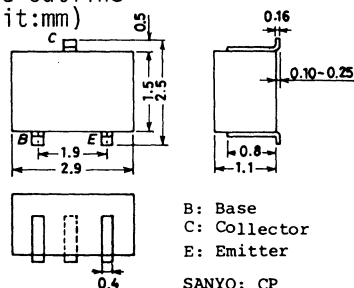
Electrical Characteristics at $T_a=25^{\circ}C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40V, I_E=0$			$(-)0.1$	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$			$(-)0.1$	μA
DC Current gain	h_{FE}	$V_{CE}=(-)5V, I_C=(-)10mA$	100*		560*	
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		300 (200)		MHz
Output Capacitance	C_{ob}	$V_{CB}=(-)10V, f=1MHz$		3.7 (5.6)		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)100mA, I_B=(-)10mA$		0.1 (0.15)	0.3 (0.4)	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)100mA, I_B=(-)10mA$		0.8	1.2	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)60$			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	$(-)50$			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu A, I_C=0$	$(-)5$			V
Turn-on Time	t_{on}	$V_{CC}=20V,$		70 (70)		ns
Storage Time	t_{stg}	$I_C=10I_{B1}=-10I_{B2}=100mA$		400 (400)		ns
Fall Time	t_f			70 (50)		ns

* : The 2SA1338/2SC3392 are classified by 10mA h_{FE} as follows:

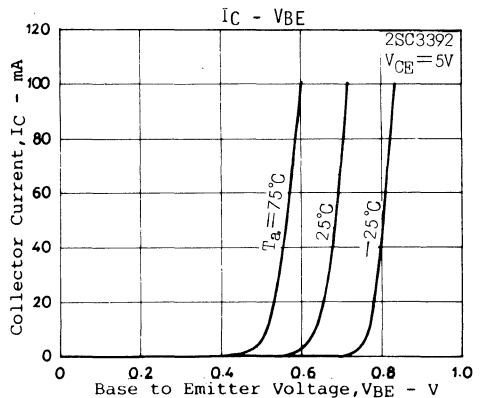
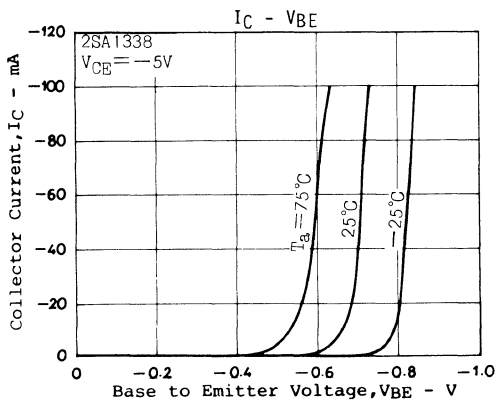
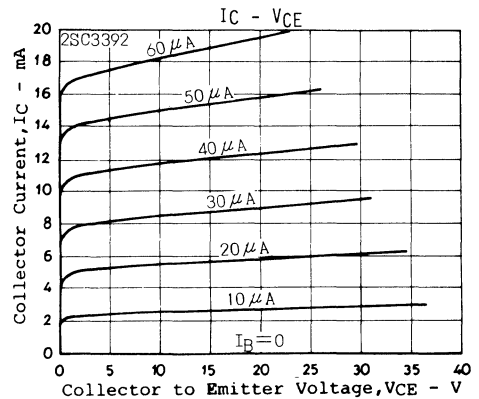
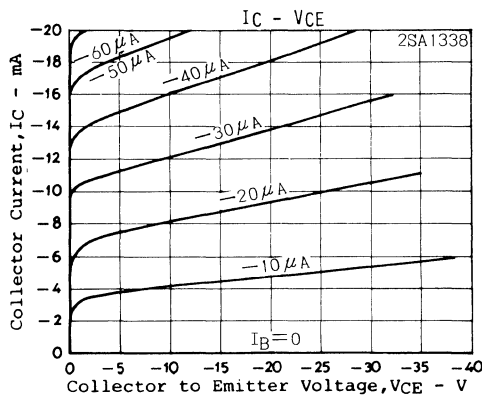
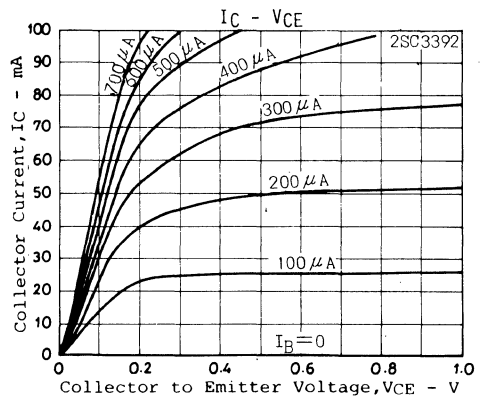
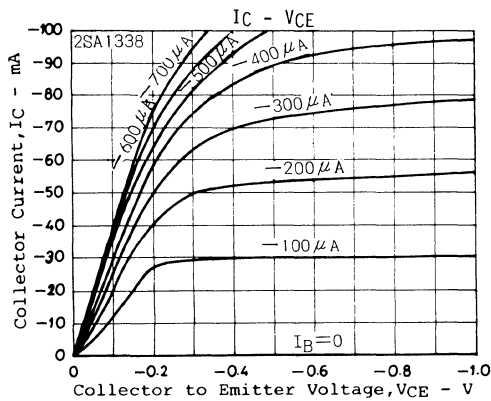
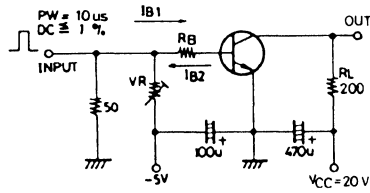
2SA1338	100	AL4	200	140	AL5	280
	200	AL6	400	280	AL7	560
2SC3392	100	AY4	200	140	AY5	280
	200	AY6	400	280	AY7	560

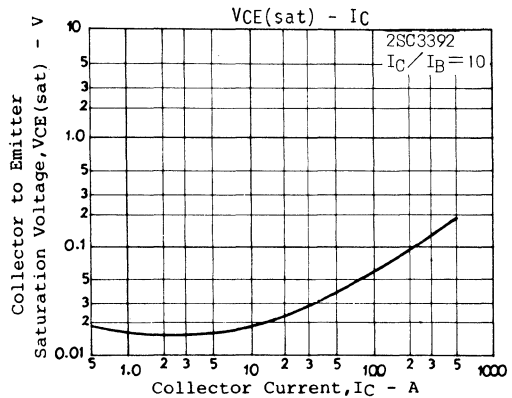
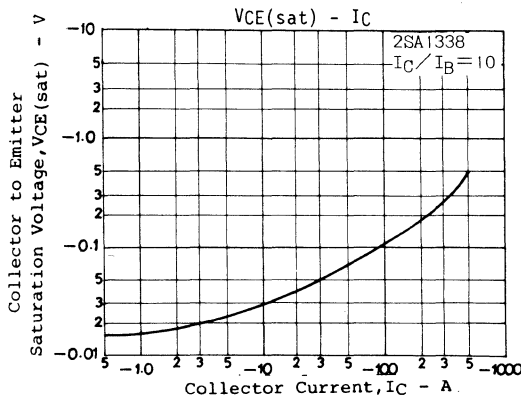
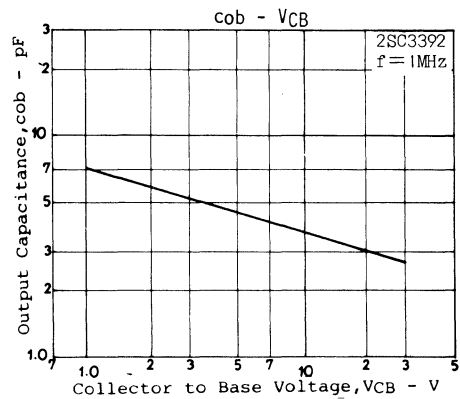
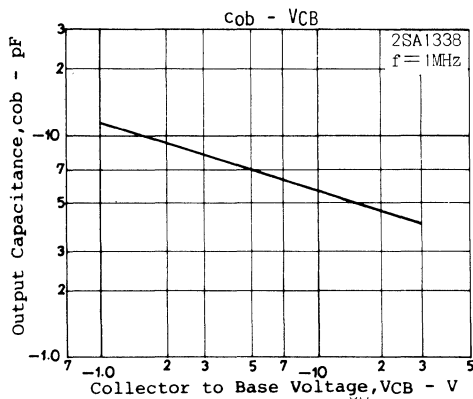
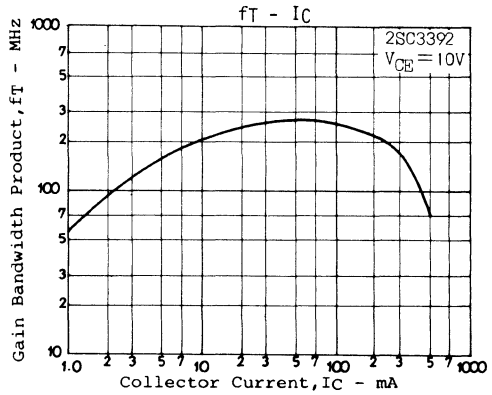
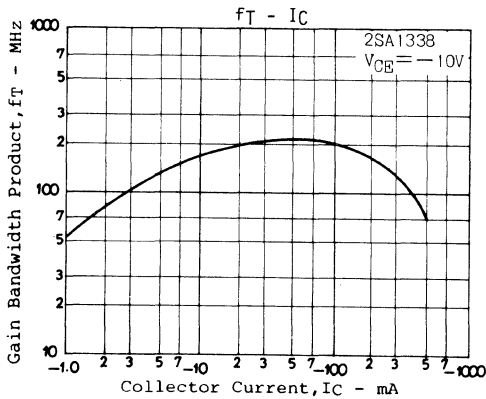
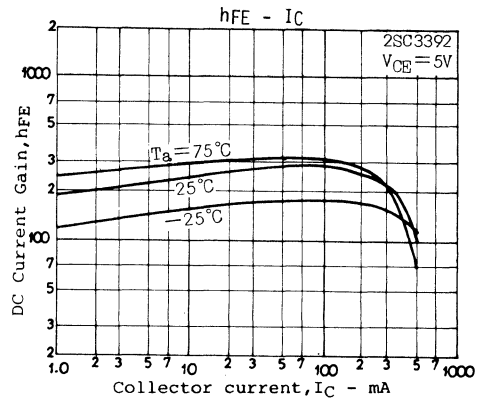
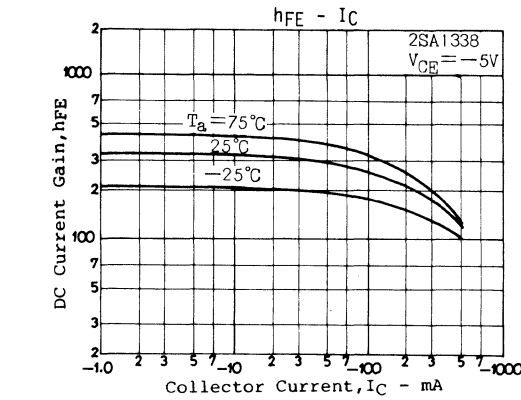
Case Outline 2018
(unit:mm)

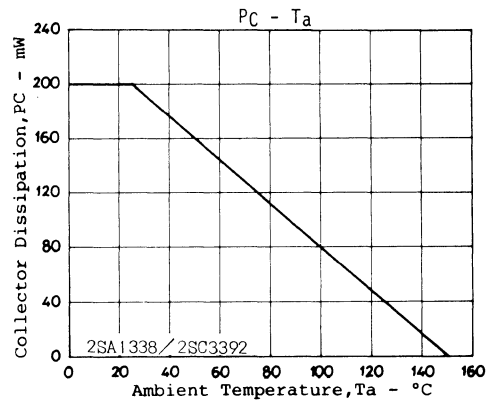
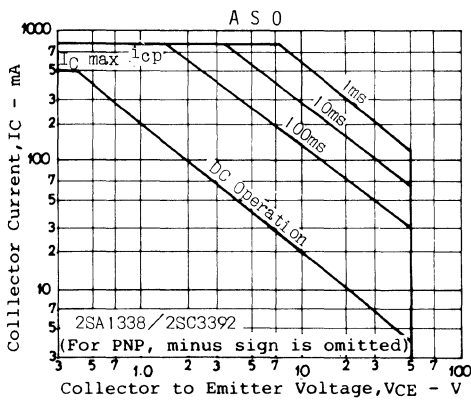
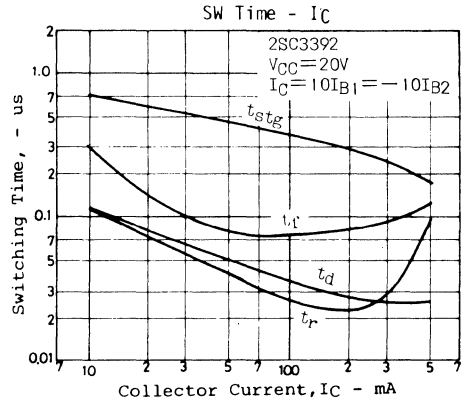
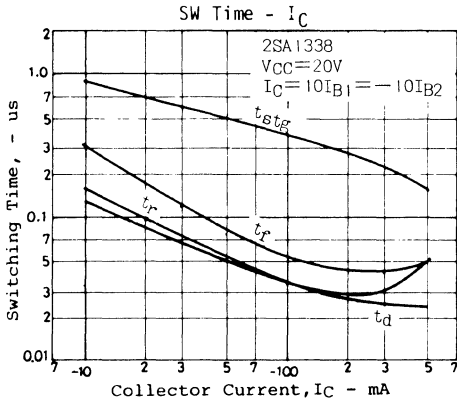
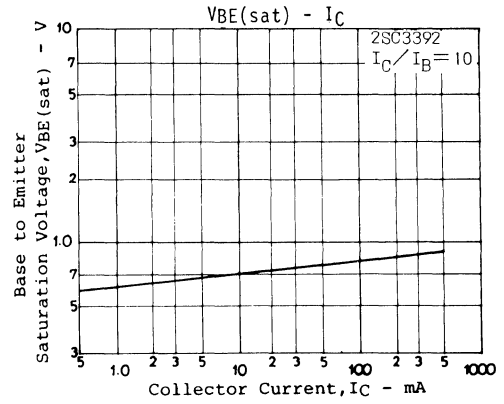
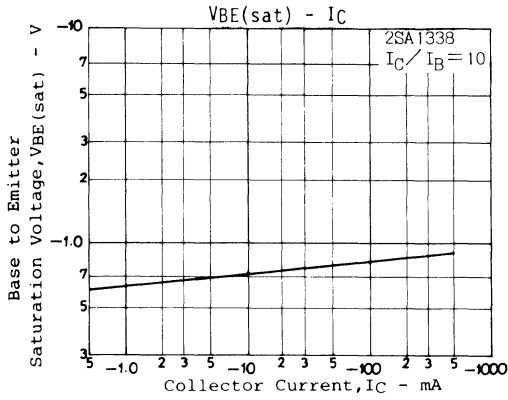


1114KI, MT No.1421-1/4

Switching Time Test Circuit







2SC3393



2033

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1339

High Speed Switching Applications

©1392

Features

- Very small-sized package permitting sets to be small-sized, slim
 - High breakdown voltage: $V_{CEO}=(-)50V$
 - Complementary pair transistor having large current capacity and high f_T
 - Adoption of FBET process
- (): 2SA1339

Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	$(-)60$	V
Collector to Emitter Voltage	V_{CEO}	$(-)50$	V
Emitter to Base Voltage	V_{EBO}	$(-)5$	V
Collector Current	I_C	$(-)500$	mA
Peak Collector Current	i_{cp}	$(-)800$	mA
Collector Dissipation	P_C	300	mW
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to $+150$	$^\circ C$

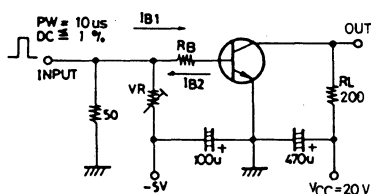
Electrical Characteristics at $T_a=25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40V, I_E=0$			$(-)0.1$	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V$			$(-)0.1$	μA
DC Current gain	h_{FE}	$V_{CE}=(-)5V, I_C=(-)10mA$	100*		560*	
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		300 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10V, f=1MHz$		3.7 (5.6)		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)100mA, I_B=(-)10mA$		0.1 (0.15)	0.3 (0.4)	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)100mA, I_B=(-)10mA$		0.8	1.2	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)60$			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	$(-)50$			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu A, I_C=\infty$	$(-)5$			V
Rise Time	t_{on}	$V_{CC}=20V$		70 (70)		ns
Storage Time	t_{stg}	$I_C=10I_{B1}=-10I_{B2}=100mA$		400 (400)		ns
Fall Time	t_f			70 (50)		ns

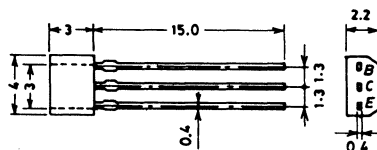
* : The 2SA1339/2SC3393 are classified by 10mA h_{FE} as follows:

100	R	200	140	S	280
200	T	400	280	U	560

Switching Time Test Circuit

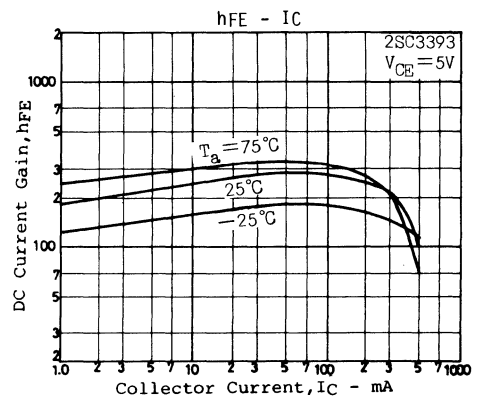
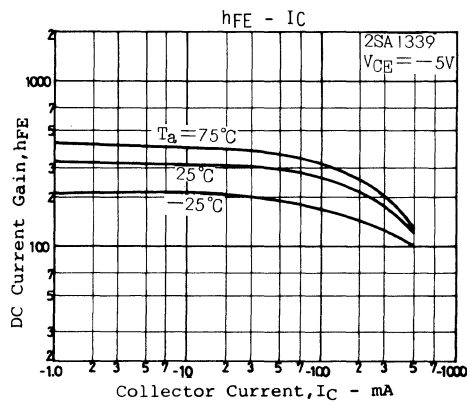
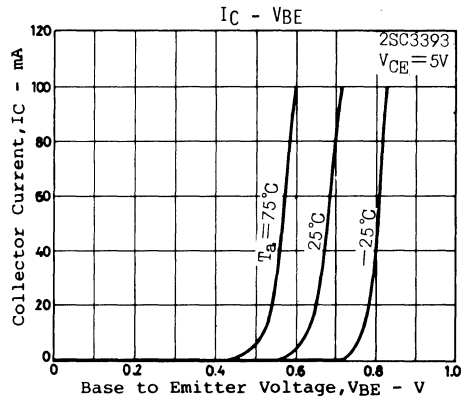
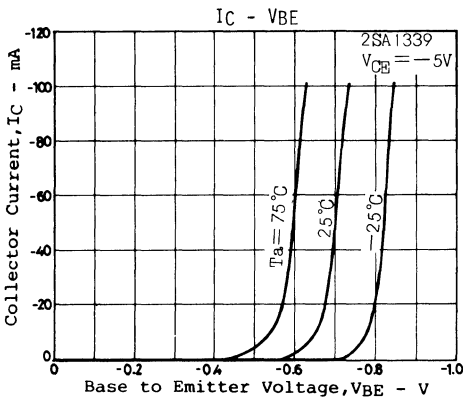
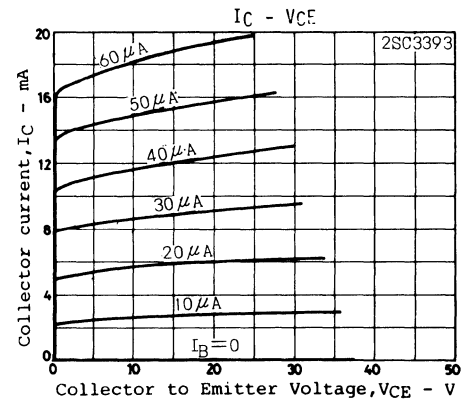
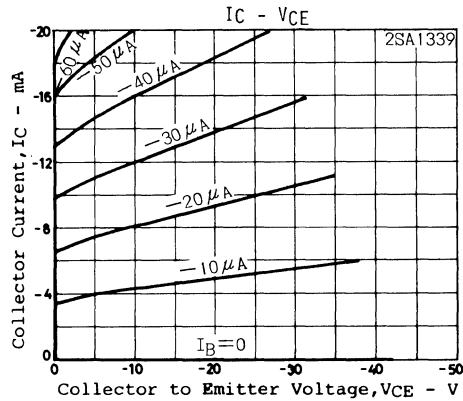
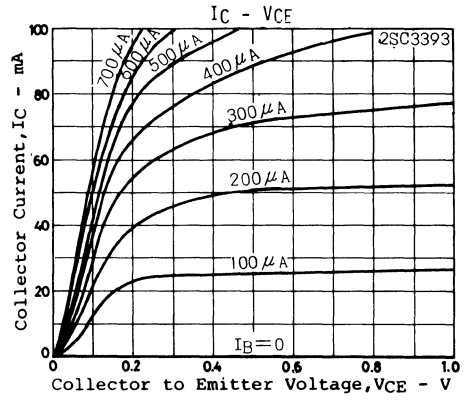
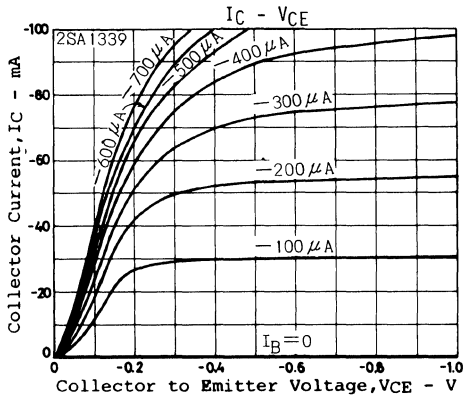


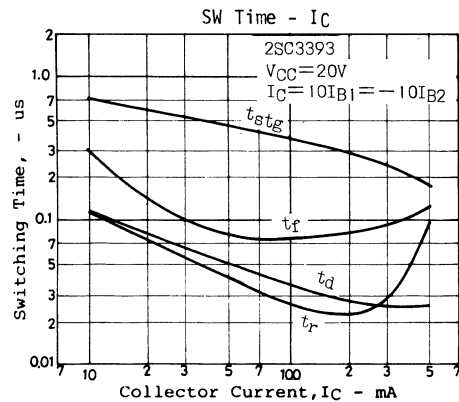
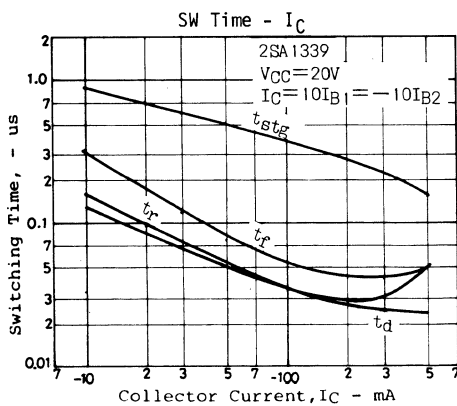
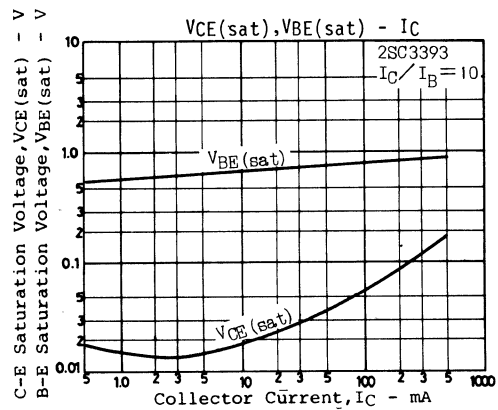
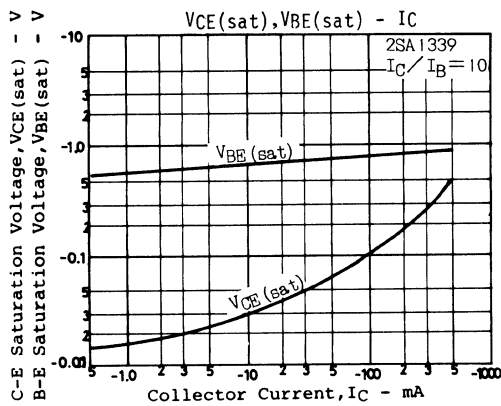
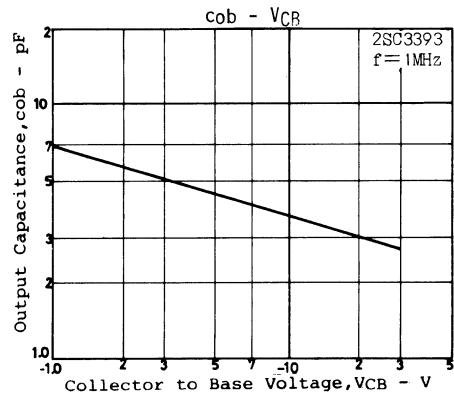
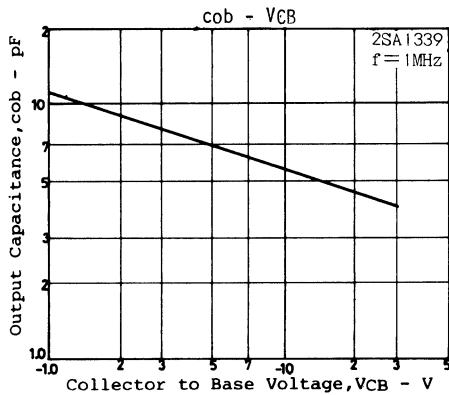
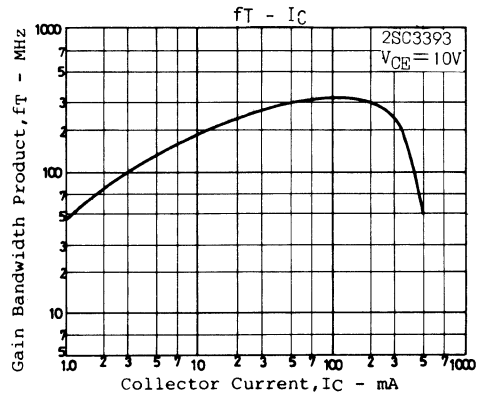
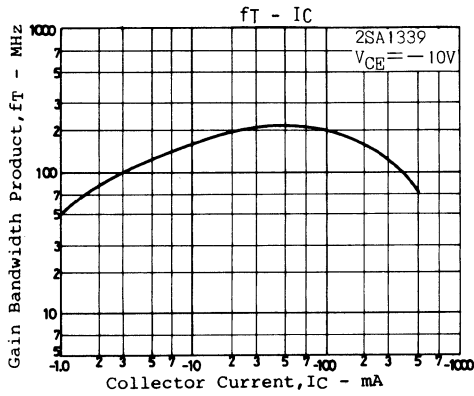
Case Outline 2033 (unit:mm)

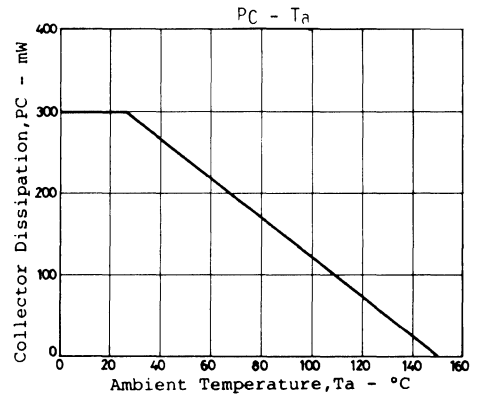
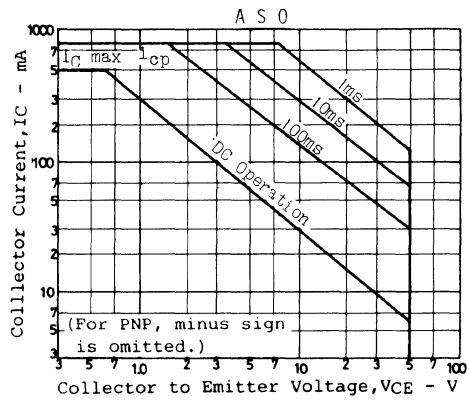


B: Base
C: Collector
E: Emitter
SANYO: SPA

1114KI,MT No.1392-1/4







2SC3395



2018

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1341

Switching Applications (with Bias Resistance)

©1283B

Applications

Switching circuit, inverter, interface circuit, driver

Features

- Built-in bias resistor ($R_1=47k\Omega$, $R_2=47k\Omega$).
- Small-sized package (CP).

(): 2SA1341

Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-) 50	V
Collector to Emitter Voltage	V_{CEO}	(-) 50	V
Emitter to Base Voltage	V_{EBO}	(-) 10	V
Collector Current	I_C	(-) 100	mA
Peak Collector Current	i_{cp}	(-) 200	mA
Collector Dissipation	P_C	200	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to $+150$	$^\circ\text{C}$

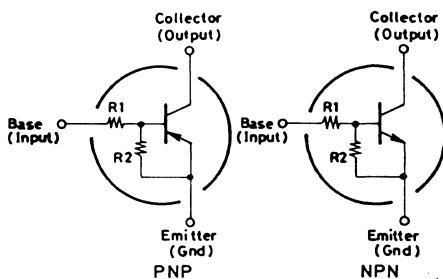
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}$, $I_E=0$			(-) 0.1	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}$, $I_B=0$			(-) 0.5	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}$, $I_C=0$	(-) 30	(-) 53	(-) 80	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}$, $I_C=(-)5\text{mA}$	50			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}$, $I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}$, $f=1\text{MHz}$		3.5 (5.3)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{mA}$, $I_B=(-)0.25\text{mA}$	(-) 0.1	(-) 0.3		V

Marking on Device

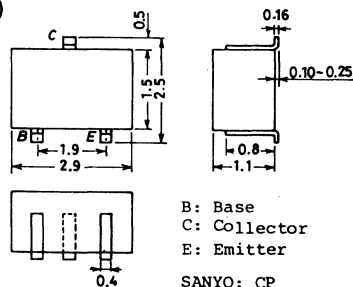
2SA1341:BL, 2SC3395:BY

Electrical Connection



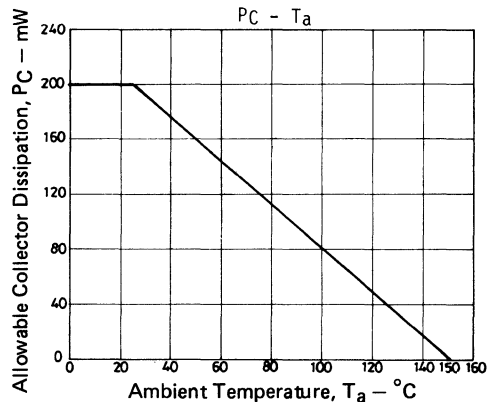
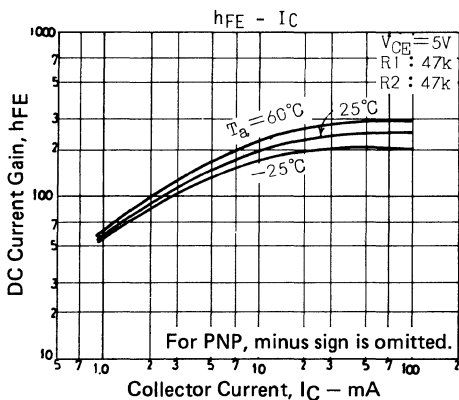
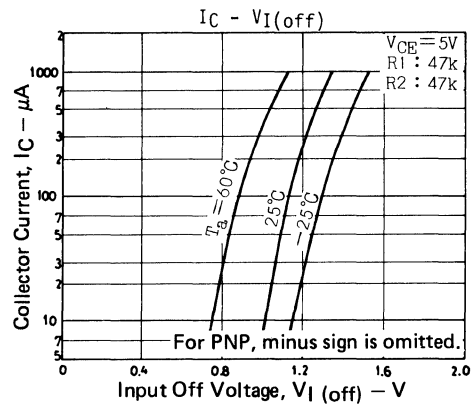
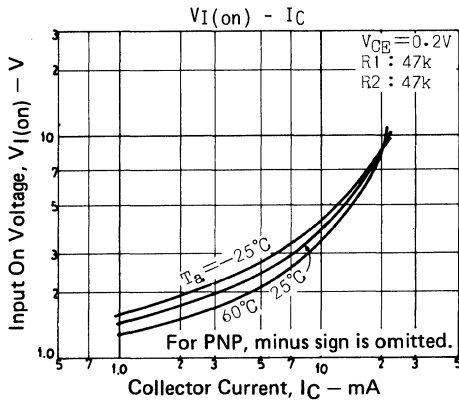
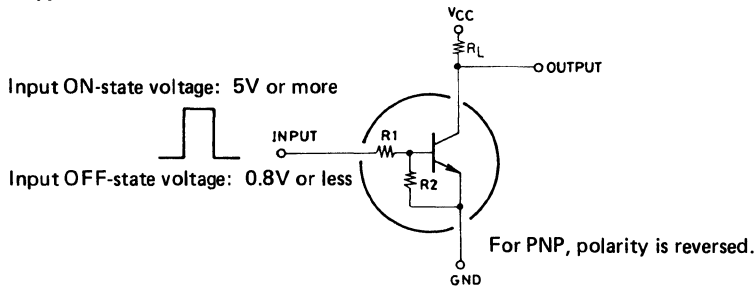
Case Outline 2018

(unit: mm)



			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)50$			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	$(-)50$			V
Input Off Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	$(-)0.8$	$(-)1.1$	$(-)1.5$	V
Input On Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)5mA$	$(-)1.0$	$(-)2.5$	$(-)5.0$	V
Input Resistance	R_1		32	47	62	k Ω
Input Resistance Ratio	R_1/R_2		0.9	1.0	1.1	—

Sample Application Circuit



2SC3396



2018

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1342

Switching Applications (with Bias Resistance)

Ⓔ1284B

Applications

Switching circuit, inverter, interface circuit, driver

Features

- Built-in bias resistor ($R_1=22k\Omega$, $R_2=22k\Omega$).
- Small-sized package (CP).

(): 2SA1342

Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)50	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)10	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	200	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

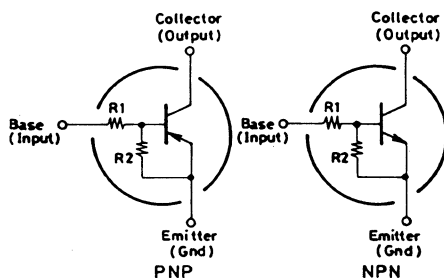
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}$, $I_E=0$			(-)0.1	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}$, $I_B=0$			(-)0.5	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}$, $I_C=0$	(-)70	(-)113	(-)150	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}$, $I_C=(-)5\text{mA}$	50			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}$, $I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}$, $f=1\text{MHz}$		3.5 (5.3)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)10\text{mA}$, $I_B=(-)0.5\text{mA}$	(-)0.1	(-)0.3		V

Marking on Device

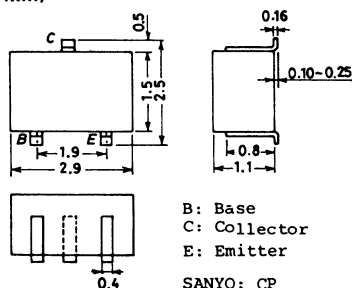
2SA1342: CL, 2SC3396: CY

Electrical Connection



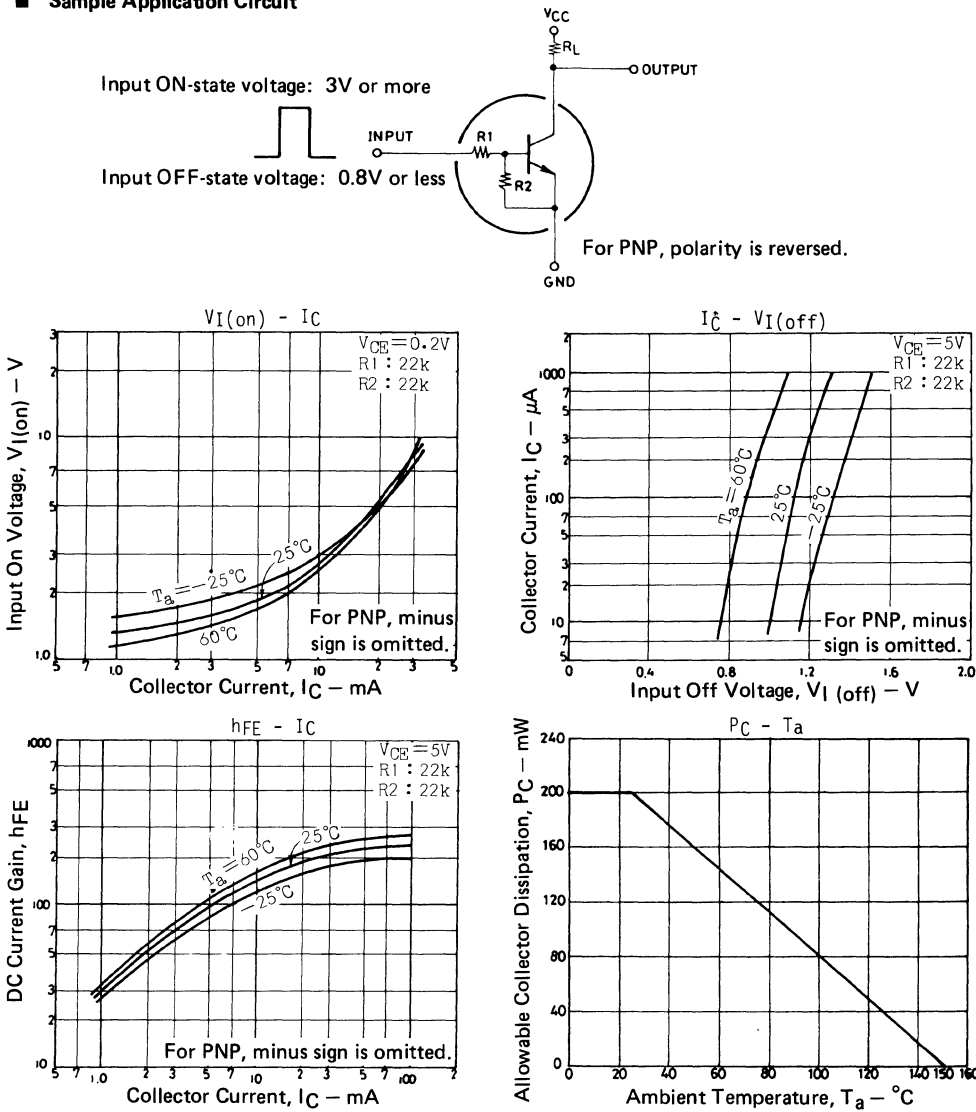
Case Outline 2018

(unit: mm)



			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)50$			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	$(-)50$			V
Input Off Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	$(-)0.8$	$(-)1.1$	$(-)1.5$	V
Input On Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)5mA$	$(-)1.0$	$(-)1.9$	$(-)3.0$	V
Input Resistance	R_1		15	22	29	k Ω
Input Resistance Ratio	R_1/R_2		0.9	1.0	1.1	—

■ Sample Application Circuit



2SC3397

2018

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1343

Switching Applications (with Bias Resistance)

©1285B

Applications

Switching circuit, inverter, interface circuit, driver

Features

- Built-in bias resistor ($R_1=46k\Omega$, $R_2=23k\Omega$).
- Small-sized package (CP).

(): 2SA1343

Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)50	V
Collector to Emitter Voltage	V_{CEO}	(-)50	V
Emitter to Base Voltage	V_{EBO}	(-)10	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	200	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

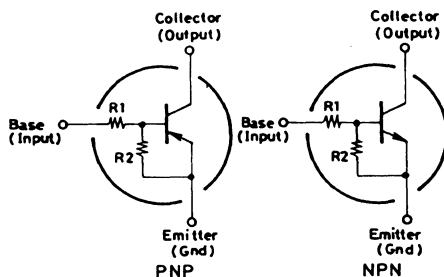
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}$, $I_E=0$			(-)0.1	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}$, $I_B=0$			(-)0.5	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}$, $I_C=0$	(-)40	(-)72	(-)100	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}$, $I_C=(-)5\text{mA}$	50			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}$, $I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}$, $f=1\text{MHz}$		3.5 (5.3)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{mA}$, $I_B=(-)0.25\text{mA}$	(-)0.1	(-)0.3		V

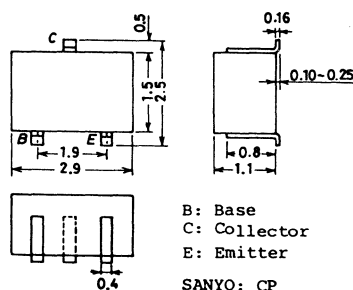
Marking on Device

2SA1343: DL, 2SC3397: DY

Electrical Connection

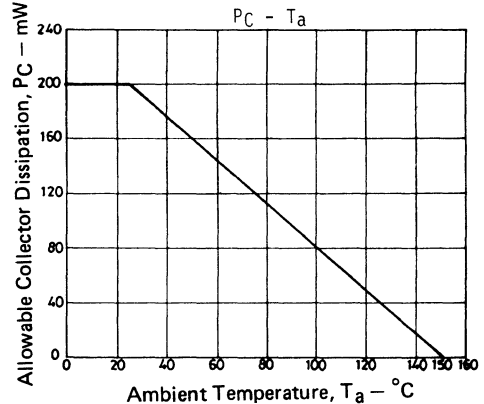
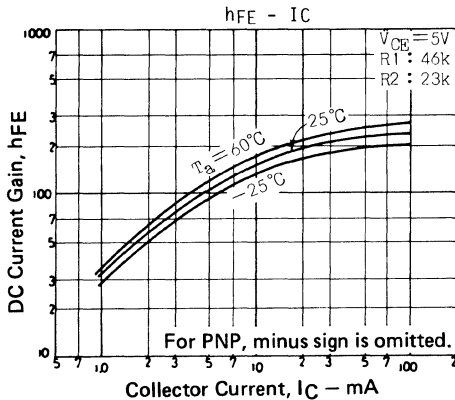
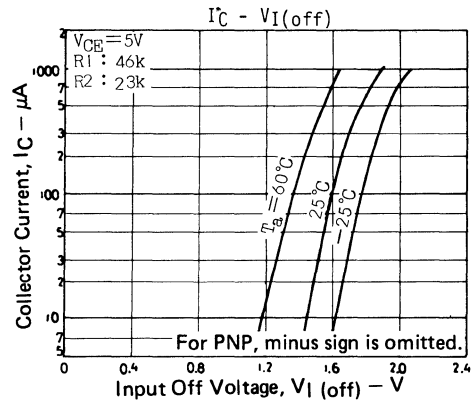
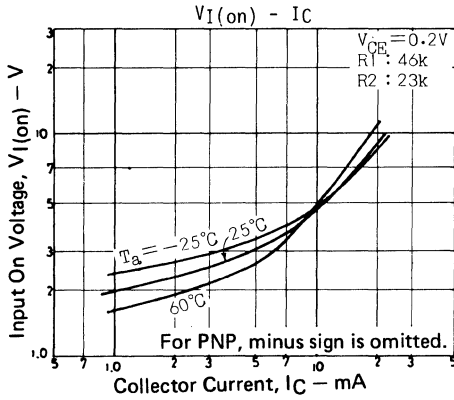
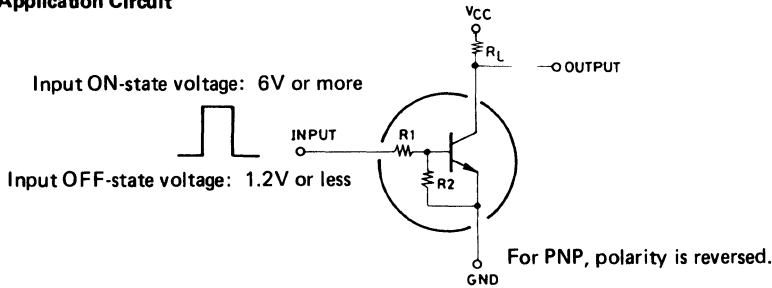


Case Outline 2018 (unit: mm)



			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	(-)50			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	(-)50			V
Input Off Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	(-)1.2	(-)1.6	(-)2.3	V
Input On Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)5mA$	(-)1.5	(-)3.1	(-)6.0	V
Input Resistance	R_1		32	46	60	k Ω
Input Resistance Ratio	R_1/R_2		1.8	2.0	2.2	—

■ Sample Application Circuit



2SC3398



2018

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1344

Switching Applications (with Bias Resistance)

©1286B

Applications

Switching circuit, inverter, interface circuit, driver

Features

- Built-in bias resistor ($R_1=10k\Omega$, $R_2=10k\Omega$).
- Small-sized package (CP).

(): 2SA1344

Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-) 50	V
Collector to Emitter Voltage	V_{CEO}	(-) 50	V
Emitter to Base Voltage	V_{EBO}	(-) 10	V
Collector Current	I_C	(-) 100	mA
Peak Collector Current	i_{cp}	(-) 200	mA
Collector Dissipation	P_C	200	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to $+150$	$^\circ\text{C}$

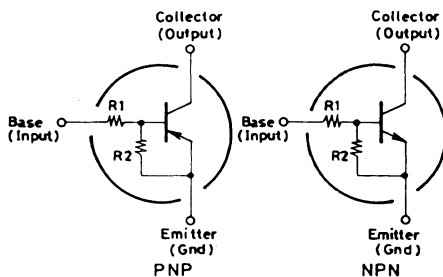
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}$, $I_E=0$			(-) 0.1	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}$, $I_B=0$			(-) 0.5	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}$, $I_C=0$	(-) 170	(-) 250	(-) 330	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}$, $I_C=(-)10\text{mA}$	50			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}$, $I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}$, $f=1\text{MHz}$		3.5 (5.3)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)10\text{mA}$, $I_B=(-)0.5\text{mA}$	(-) 0.1	(-) 0.3		V

Marking on Device

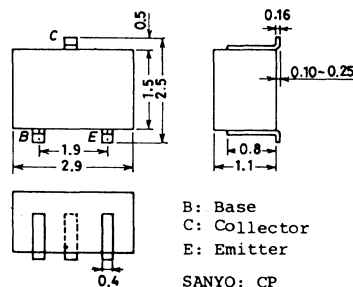
2SA1344: EL, 2SC3398: EY

Electrical Connection



Case Outline 2018

(unit: mm)

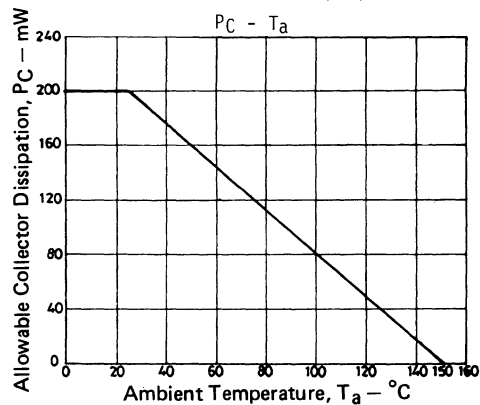
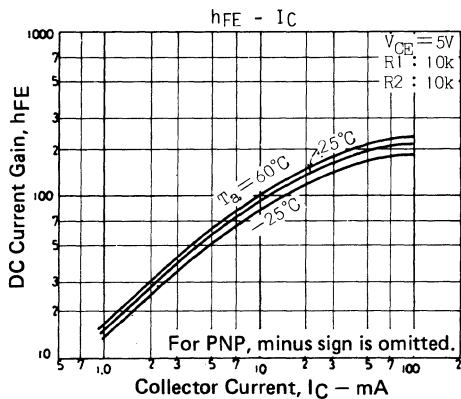
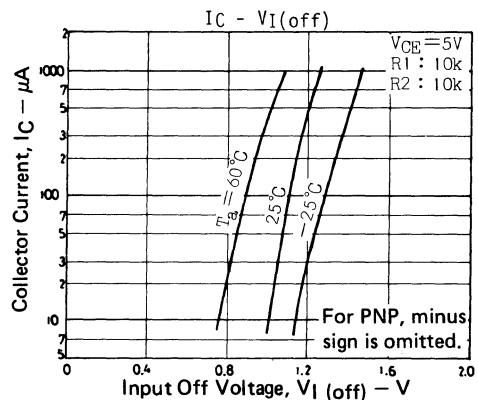
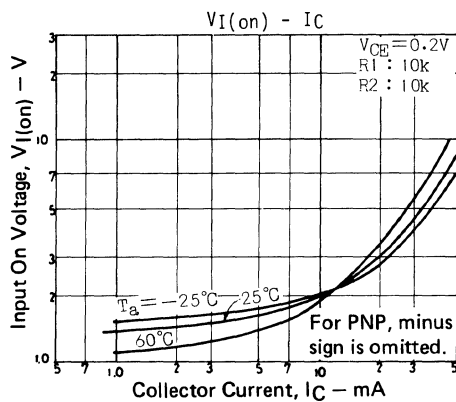
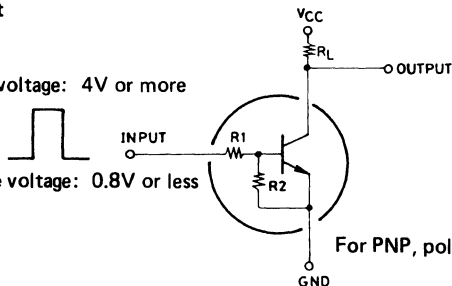


			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	(-)50			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	(-)50			V
Input Off Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	(-)0.8	(-)1.1	(-)1.5	V
Input On Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)10mA$	(-)1.0	(-)2.0	(-)4.0	V
Input Resistance	R_1		7.0	10	13	k Ω
Input Resistance Ratio	R_1/R_2		0.9	1.0	1.1	—

■ Sample Application Circuit

Input ON-state voltage: 4V or more

Input OFF-state voltage: 0.8V or less



2SC3399



2033

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1345

Switching Applications (with Bias Resistance)

©1287B

Applications

Switching circuit, inverter, interface circuit, driver

Features

- Built-in bias resistor ($R_1=47k\Omega$, $R_2=47k\Omega$).
- Small-sized package (SPA).

(): 2SA1345

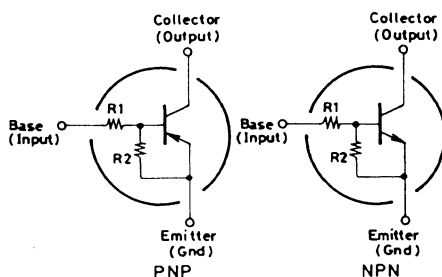
Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)50	V
Collector to Emitter Voltage	V_{CEO}	(-)50	V
Emitter to Base Voltage	V_{EBO}	(-)10	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	300	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

Electrical Characteristics/ $T_a=25^\circ\text{C}$

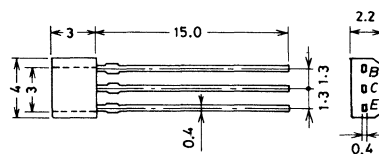
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}$, $I_E=0$			(-)0.1	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}$, $I_B=0$			(-)0.5	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}$, $I_C=0$	(-)30	(-)53	(-)80	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}$, $I_C=(-)5\text{mA}$	50			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}$, $I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}$, $f=1\text{MHz}$		3.7 (5.5)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{mA}$, $I_B=(-)0.25\text{mA}$	(-)0.1	(-)0.3		V

Electrical Connection



Case Outline 2033

(unit: mm)



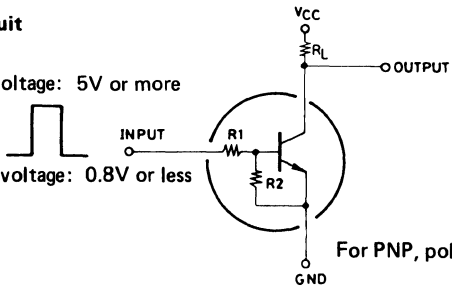
B: Base
C: Collector
E: Emitter
SANYO: SPA

			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)50$			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	$(-)50$			V
Input Off Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	$(-)0.8$	$(-)1.1$	$(-)1.5$	V
Input On Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)5mA$	$(-)1.0$	$(-)2.5$	$(-)5.0$	V
Input Resistance	R_1		32	47	62	k Ω
Input Resistance Ratio	R_1/R_2		0.9	1.0	1.1	—

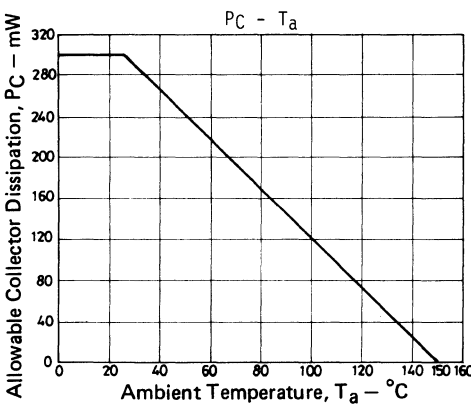
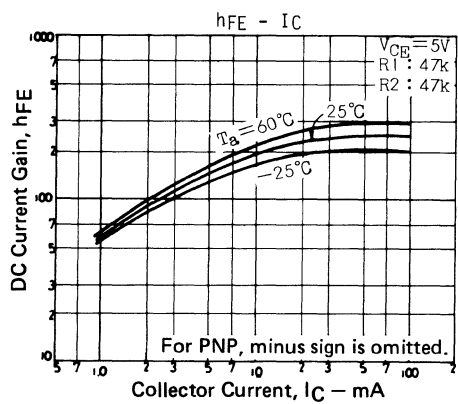
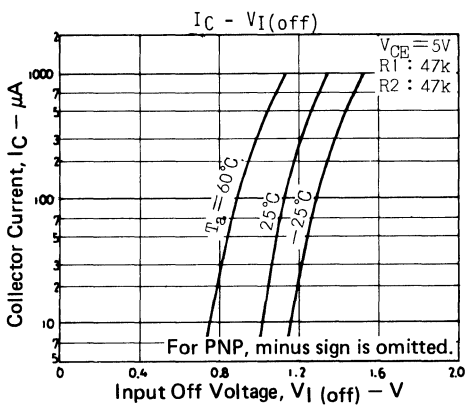
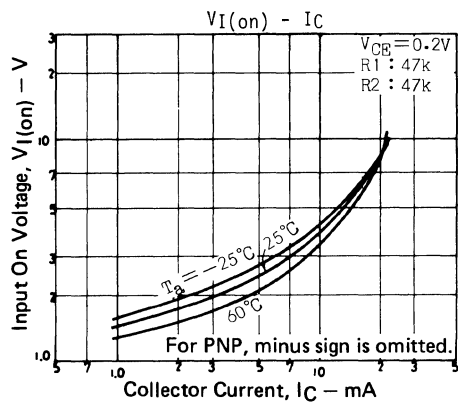
■ Sample Application Circuit

Input ON-state voltage: 5V or more

Input OFF-state voltage: 0.8V or less



For PNP, polarity is reversed.



2SC3400



2033

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1346

Switching Applications (with Bias Resistance)

©1288B

Applications

Switching circuit, inverter, interface circuit, driver

Features

- Built-in bias resistor ($R_1=22k\Omega$, $R_2=22k\Omega$).
- Small-sized package (SPA).

(): 2SA1346

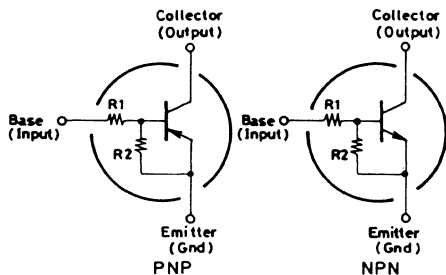
Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)50	V
Collector to Emitter Voltage	V_{CEO}	(-)50	V
Emitter to Base Voltage	V_{EBO}	(-)10	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	300	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

Electrical Characteristics/ $T_a=25^\circ\text{C}$

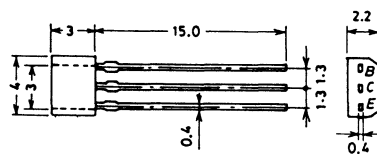
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}$, $I_E=0$			(-)0.1	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}$, $I_B=0$			(-)0.5	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}$, $I_C=0$	(-)70	(-)113	(-)150	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}$, $I_C=(-)5\text{mA}$	50			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}$, $I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}$, $f=1\text{MHz}$		3.7 (5.5)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)10\text{mA}$, $I_B=(-)0.5\text{mA}$	(-)0.1	(-)0.3		V

Electrical Connection



Case Outline 2033

(unit: mm)



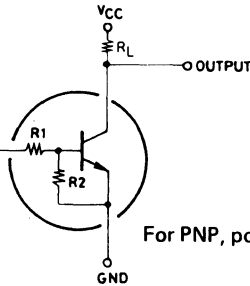
B: Base
C: Collector
E: Emitter
SANYO: SPA

			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	(-)50			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	(-)50			V
Input Off Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	(-)0.8	(-)1.1	(-)1.5	V
Input On Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)5mA$	(-)1.0	(-)1.9	(-)3.0	V
Input Resistance	R_1		15	22	29	k Ω
Input Resistance Ratio	R_1/R_2		0.9	1.0	1.1	—

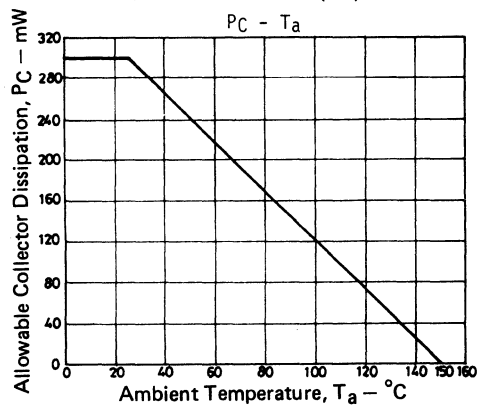
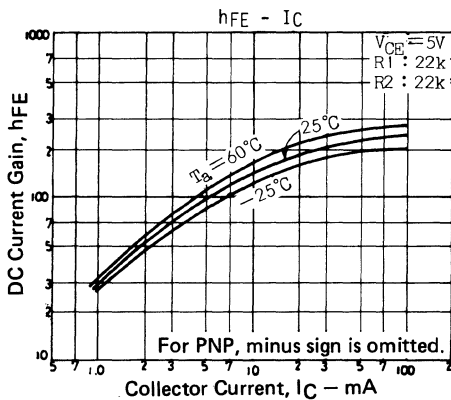
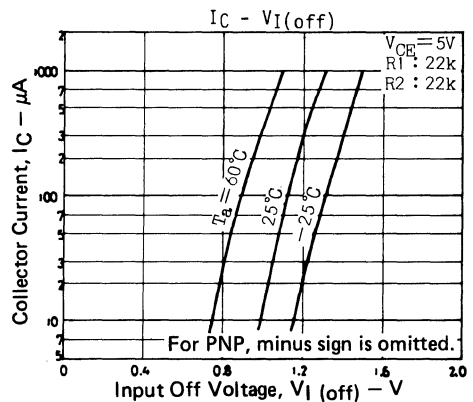
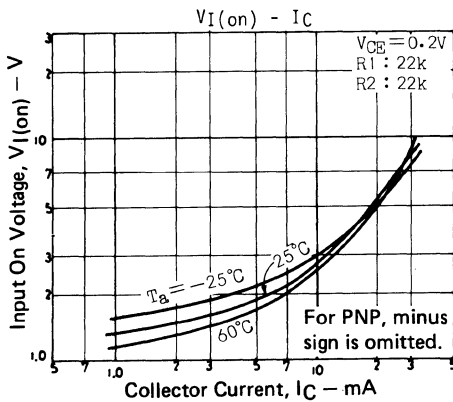
■ Sample Application Circuit

Input ON-state voltage: 3V or more

Input OFF-state voltage: 0.8V or less



For PNP, polarity is reversed.





2033

NPN/PNP Epitaxial Planar Silicon Transistors

2SA1347

Switching Applications (with Bias Resistance)

Ⓔ1289B

Applications

Switching circuit, inverter, interface circuit, driver

Features

- Built-in bias resistor ($R_1=46k\Omega$, $R_2=23k\Omega$).
- Small-sized package (SPA).

(): 2SA1347

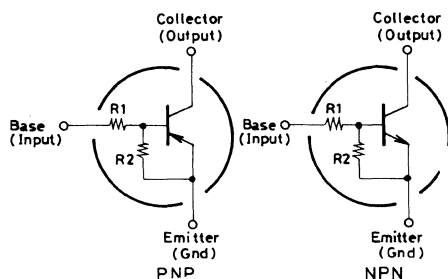
Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$

Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$			unit
Collector to Base Voltage	V_{CB0}	(-) 50	V
Collector to Emitter Voltage	V_{CE0}	(-) 50	V
Emitter to Base Voltage	V_{EB0}	(-) 10	V
Collector Current	I_C	(-) 100	mA
Peak Collector Current	i_{cp}	(-) 200	mA
Collector Dissipation	P_C	300	mW
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{sta}	-55 to $+150$	$^{\circ}\text{C}$

Electrical Characteristics/ $T_a=25^{\circ}\text{C}$

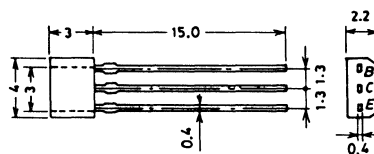
Electrical Characteristics/ $T_a=25^{\circ}\text{C}$			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			$(-)0.1$	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}, I_B=0$			$(-)0.5$	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$	$(-)40$	$(-)72$	$(-)100$	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}, I_C=(-)5\text{mA}$	50			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	C_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		3.7 (5.5)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{mA}, I_B=(-)0.25\text{mA}$	$(-)0.1$	$(-)0.3$		V

Electrical Connection



Case Outline 2033

(unit: mm)



B: Base
C: Collector
E: Emitter

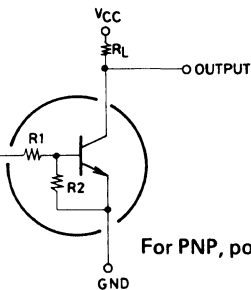
SANYO: SPA

			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	$(-)\text{50}$			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	$(-)\text{50}$			V
Input Off Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	$(-)\text{1.2}$	$(-)\text{1.6}$	$(-)\text{2.3}$	V
Input On Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)5mA$	$(-)\text{1.5}$	$(-)\text{3.1}$	$(-)\text{6.0}$	V
Input Resistance	R_1		32	46	60	k Ω
Input Resistance Ratio	R_1/R_2		1.8	2.0	2.2	—

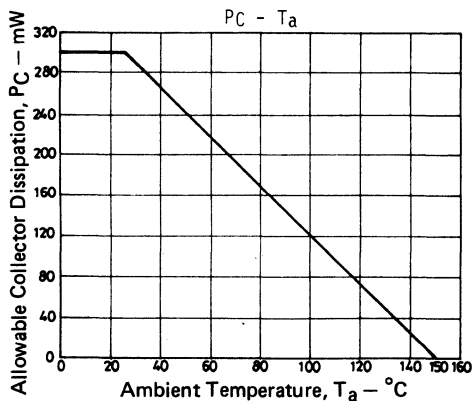
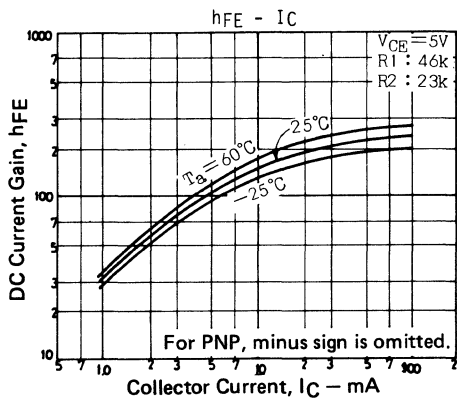
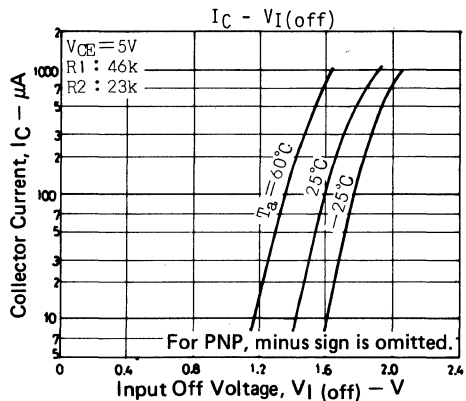
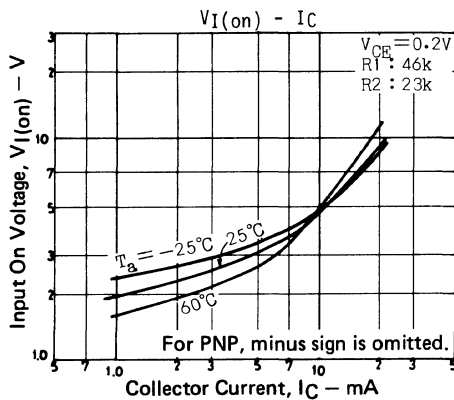
■ Sample Application Circuit

Input ON-state voltage: 6V or more

Input OFF-state voltage: 1.2V or less



For PNP, polarity is reversed.



2SC3402



2033

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1348

Switching Applications (with Bias Resistance)

©1290B

Applications

Switching circuit, inverter, interface circuit, driver

Features

- Built-in bias resistor ($R_1=10k\Omega$, $R_2=10k\Omega$).
- Small-sized package (SPA).

(): 2SA1348

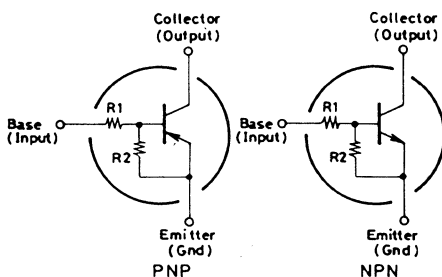
Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)50	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)10	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	300	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

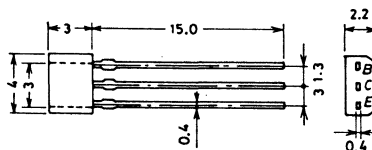
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}$, $I_E=0$			(-)0.1	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}$, $I_B=0$			(-)0.5	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}$, $I_C=0$	(-)170	(-)250	(-)330	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}$, $I_C=(-)10\text{mA}$	50			
Gain Band-width product	f_T	$V_{CE}=(-)10\text{V}$, $I_C=(-)5\text{mA}$		250 (200)		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}$, $f=1\text{MHz}$		3.7 (5.5)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)10\text{mA}$, $I_B=(-)0.5\text{mA}$	(-)0.1	(-)0.3		V

Electrical Connection



Case Outline 2033 (unit: mm)



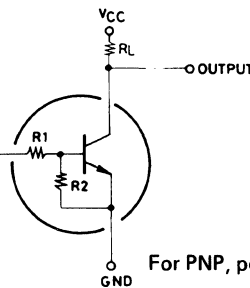
B: Base
C: Collector
E: Emitter
SANYO: SPA

			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	(-) 50			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu A, R_{BE}=\infty$	(-) 50			V
Input Off Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	(-) 0.8	(-) 1.1	(-) 1.5	V
Input On Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)10mA$	(-) 1.0	(-) 2.0	(-) 4.0	V
Input Resistance	R_1		7.0	10	13	k Ω
Input Resistance Ratio	R_1/R_2		0.9	1.0	1.1	—

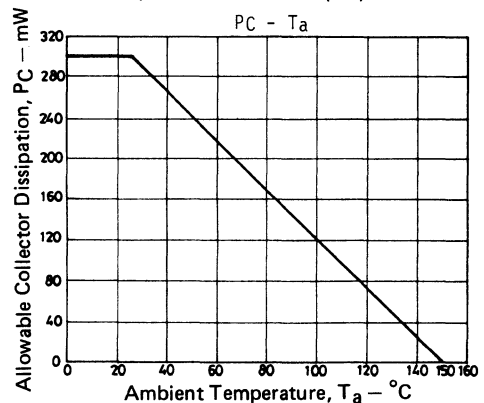
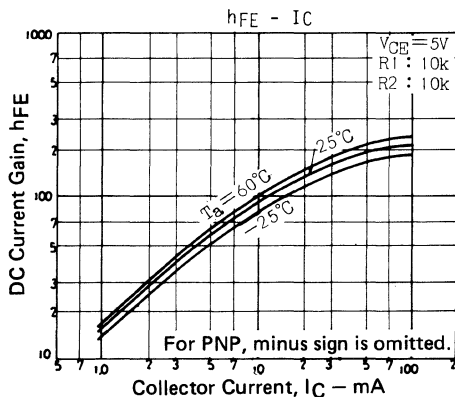
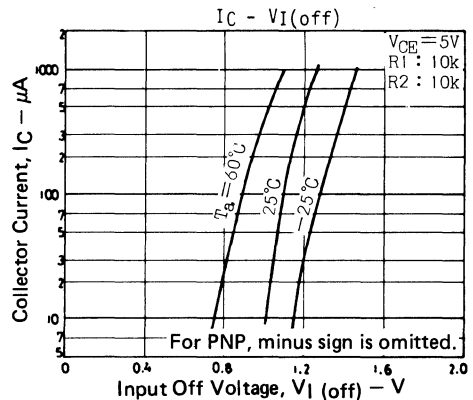
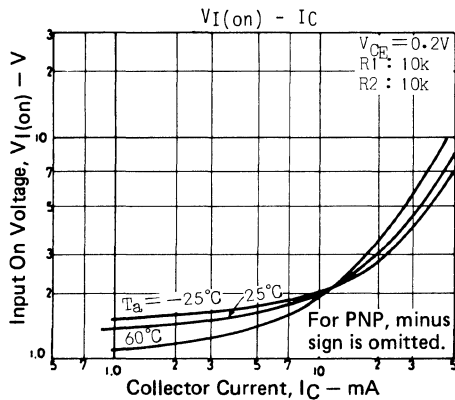
■ Sample Application Circuit

Input ON-state voltage: 4V or more

Input OFF-state voltage: 0.8V or less



For PNP, polarity is reversed.





2009

NPN/PNP Epitaxial Planar Silicon Transistors

2SA1352

High-Definition CRT Display Video Output Applications

⑤1411A

Use

- Color TV Chroma output and high breakdown voltage driver

Features

- High breakdown voltage: $V_{CEO} \geq 200V$
 - Small reverse transfer capacitance and excellent high frequency characteristic
 $c_{re} = 1.2pF(NPN), 1.7pF(PNP)$
 - Adoption of FBET process
- () : 2SA1352

Absolute Maximum Ratings at Ta=25°C

Absolute Maximum Ratings at Ta=25°C				unit
Collector to Base Voltage	VCBO	(-)	200	V
Collector to Emitter Voltage	VCEO	(-)	200	V
Emitter to Base Voltage	VEBO	(-)	5	V
Collector Current	IC	(-)	100	mA
Peak Collector Current	icp	(-)	200	mA
Collector Dissipation	PC		1.2	W
		Tc=25°C	5	W
Junction Temperature	Tj		150	°C
Storage Temperature	Tstg		-55 to +150	°C

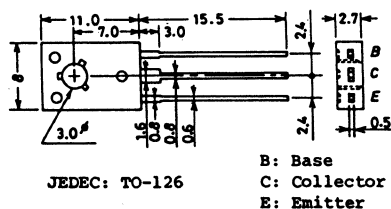
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

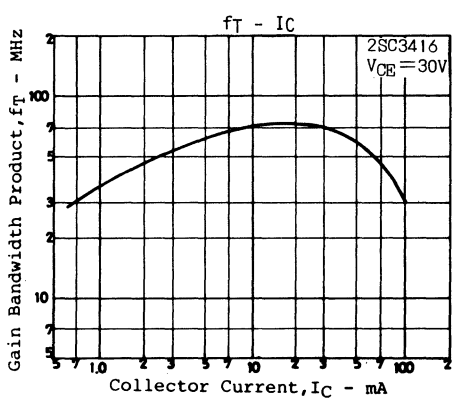
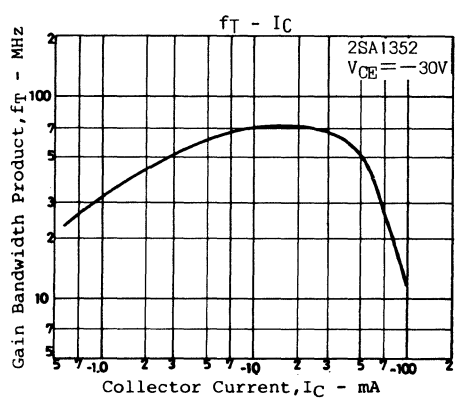
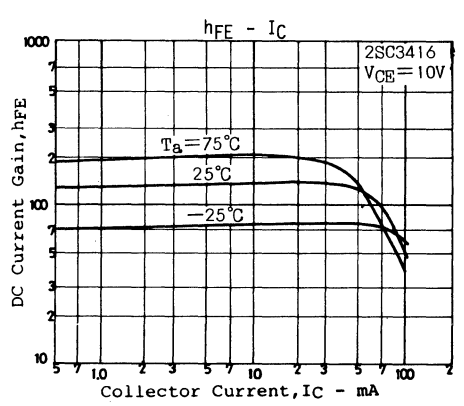
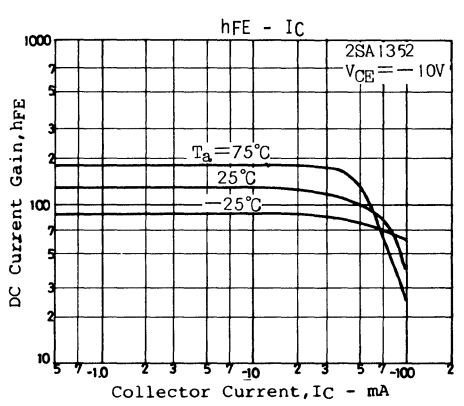
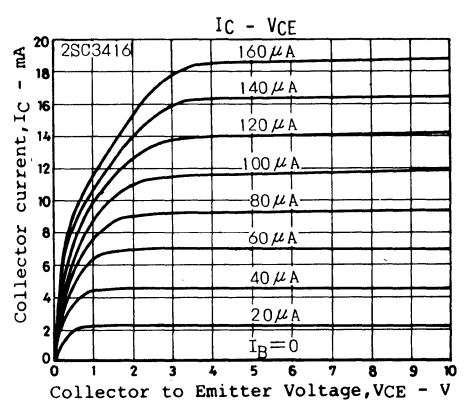
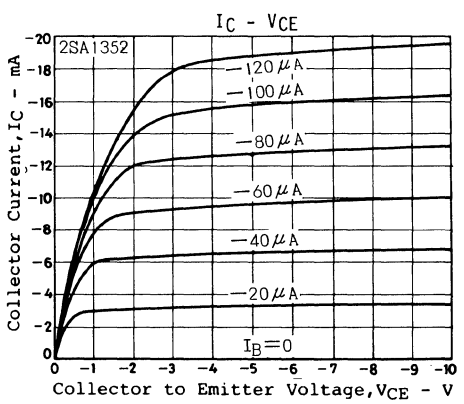
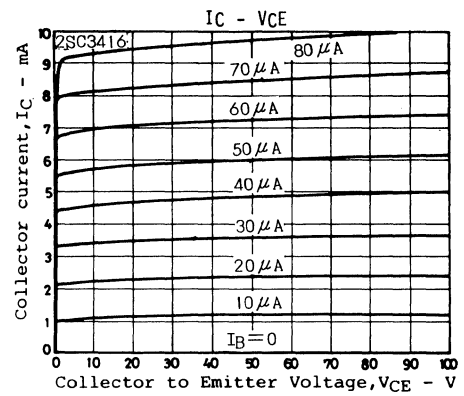
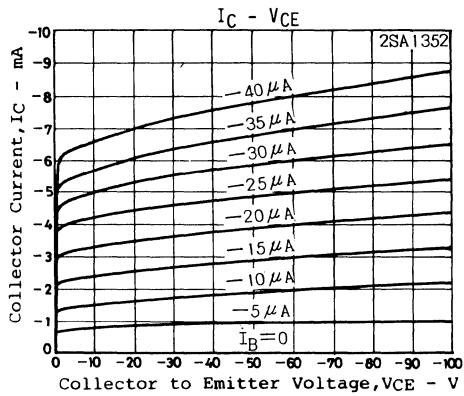
Electrical Characteristics at Ta=25°C			min	typ	max	unit
Collector Cutoff Current	ICBO	VCB=(-) 150V, IE=0			(-) 0.1	uA
Emitter Cutoff Current	IEBO	VEB=(-) 4V, IC=0			(-) 0.1	uA
DC Current Gain	hFE	VCE=(-) 40V, IC=(-) 10mA	40*		320*	
Gain Bandwidth Product	ft	VCE=(-) 30V, IC=(-) 10mA		70		MHz
C-E Saturation Voltage	VCE(sat)	IC=(-) 20mA, IB=(-) 2mA			(-) 0.6	V
B-E Saturation Voltage	VBE(sat)	IC=(-) 20mA, IB=(-) 2mA			(-) 1.0	V
C-B Breakdown Voltage	V(BR)CBO	IC=(-) 10uA, IE=0	(-) 200			V
C-E Breakdown Voltage	V(BR)CEO	IC=(-) 1mA, RBE=∞	(-) 200			V
E-B Breakdown Voltage	V(BR)EBO	IE=(-) 10uA, IC=∞	(-) 5			V
Output Capacitance	cob	VCB=(-) 30V, f=1MHz		1.7 (2.6)		pF
Reverse Transfer Capacitance	cre	VCB=(-) 30V, f=1MHz		1.2 (1.7)		pF

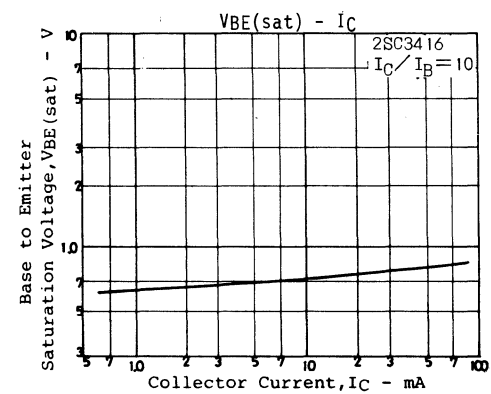
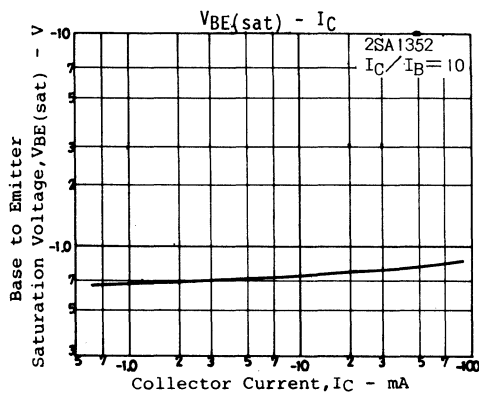
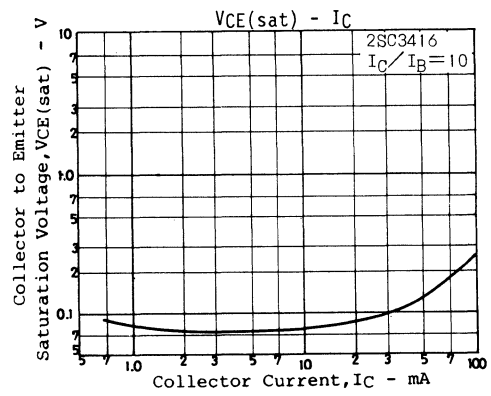
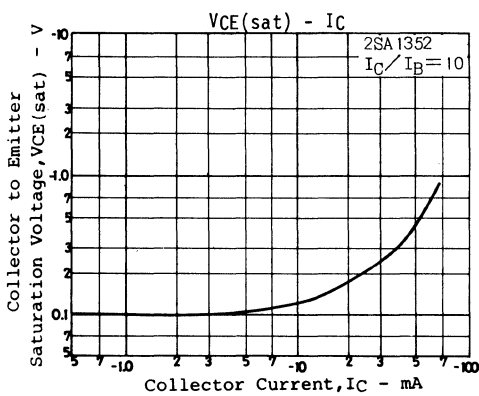
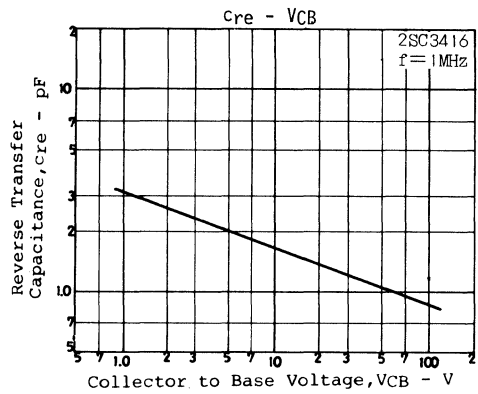
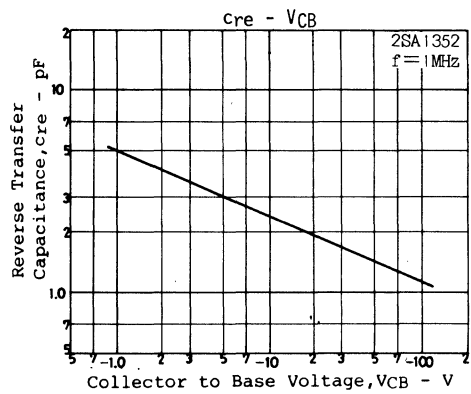
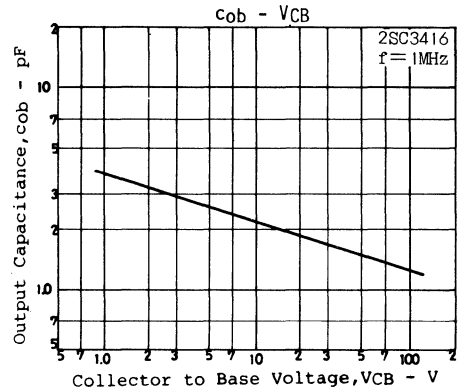
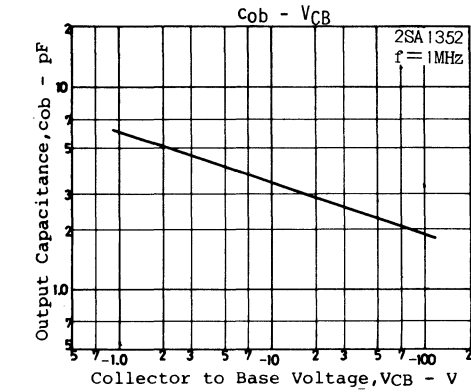
* : The 2SA1352/2SC3416 are classified by 10mA hFE as follows:

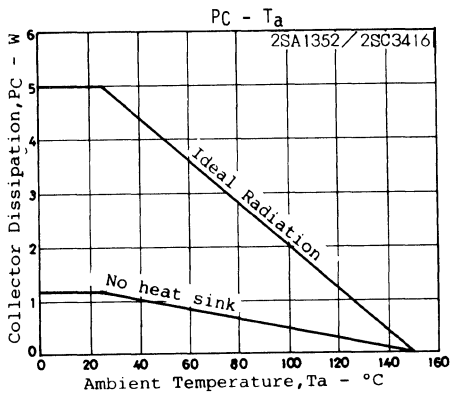
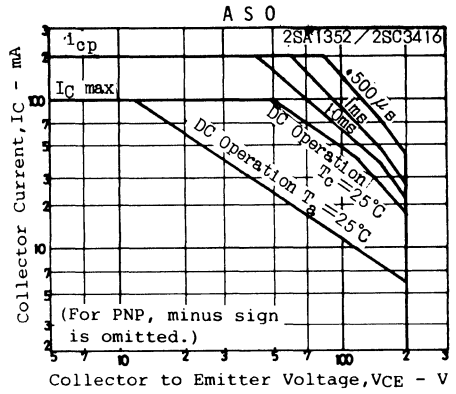
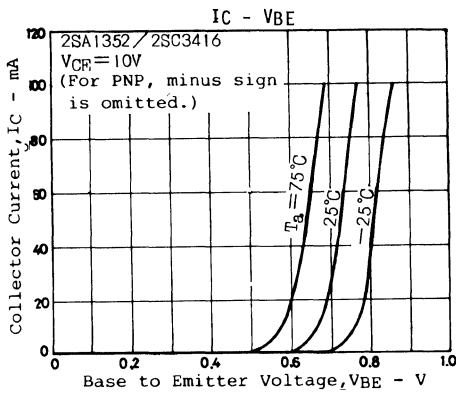
40	C	80	60	D	120	100	E	200	160	F	320
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Case Outline 2009
(unit:mm)









2SC3417



2009

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1353

High-Definition CRT Display Video Output Applications

©1390B

Use

- High-definition CRT display
- Color TV chroma output and high breakdown voltage driver

Features

- High breakdown voltage: $V_{CE0} \geq 300V$
- Excellent high frequency characteristic: $c_{re} = 1.8pF$ (typ)
- Adoption of MBIT process

(): 2SA1353

Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	(-) 300	V
Collector to Emitter Voltage	V_{CEO}	(-) 300	V
Emitter to Base Voltage	V_{EBO}	(-) 5	V
Collector Current	I_C	(-) 100	mA
Peak Collector Current	i_{cp}	(-) 200	mA
Collector Dissipation	P_C	1.2	W
	$T_c = 25^\circ C$	7	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

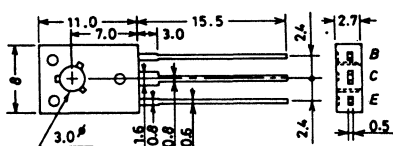
Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-) 200V, I_E = 0$			(-) 0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-) 4V, I_C = 0$			(-) 0.1	μA
DC Current Gain	h_{FE}^*	$V_{CE} = (-) 10V, I_C = (-) 10mA$	40		320	
Gain Bandwidth Product	f_T	$V_{CE} = (-) 30V, I_C = (-) 10mA$		70		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-) 20mA, I_B = (-) 2mA$			(-) 0.6	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = (-) 20mA, I_B = (-) 2mA$			(-) 1.0	V
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C = (-) 10\mu A, I_E = 0$	(-) 300			V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_E = (-) 1mA, R_{BE} = \infty$	(-) 300			V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E = (-) 10\mu A, I_C = 0$	(-) 5			V
Output Capacitance	c_{ob}	$V_{CB} = (-) 30V, f = 1MHz$		2.6 (3.1)		pF
Reverse Transfer Capacitance	c_{re}	$V_{CB} = (-) 30V, f = 1MHz$		1.8 (2.3)		pF

* : The 2SA1353/2SC3417 are classified by 10mA h_{FE} as follows:

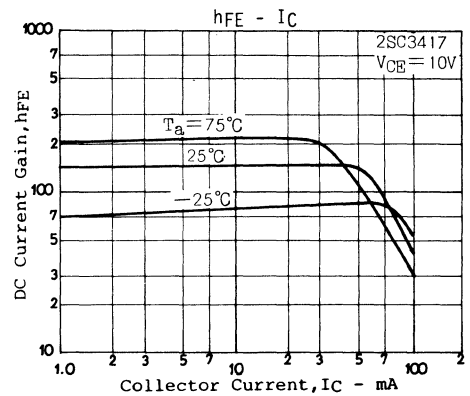
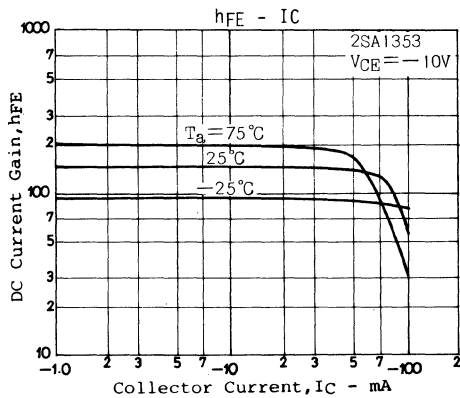
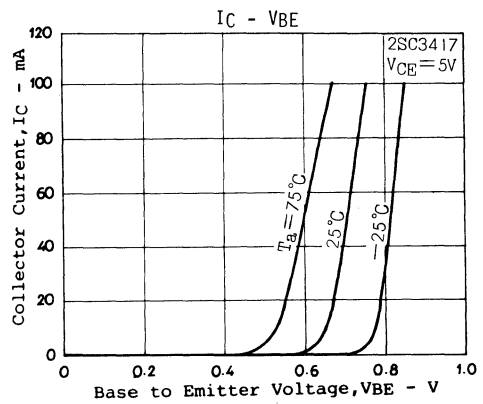
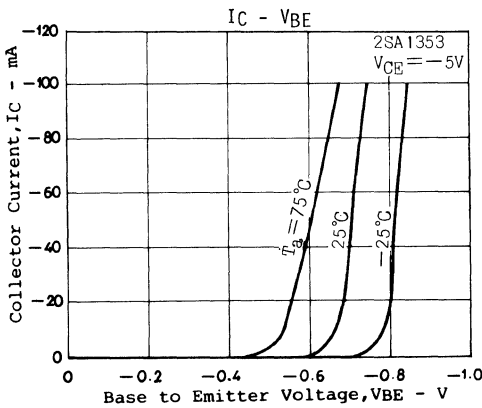
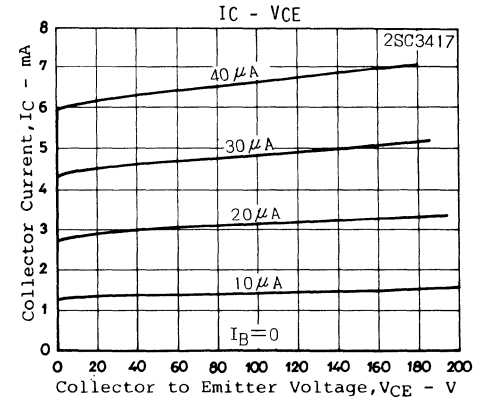
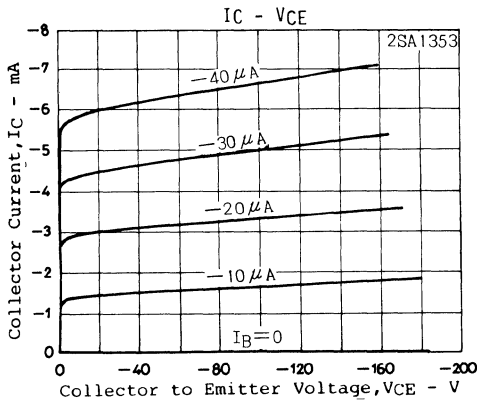
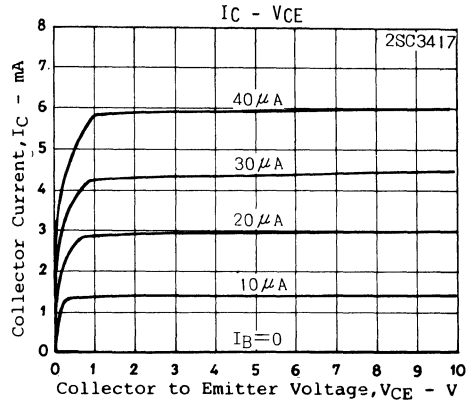
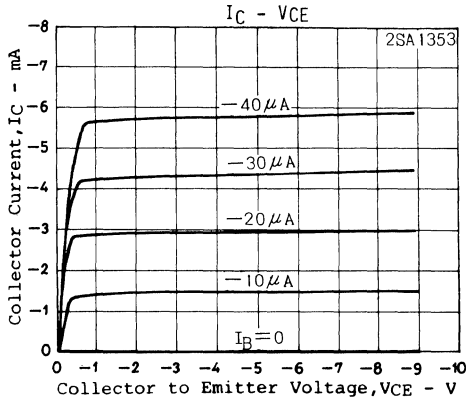
40	C	80	60	D	120	100	E	200	160	F	320
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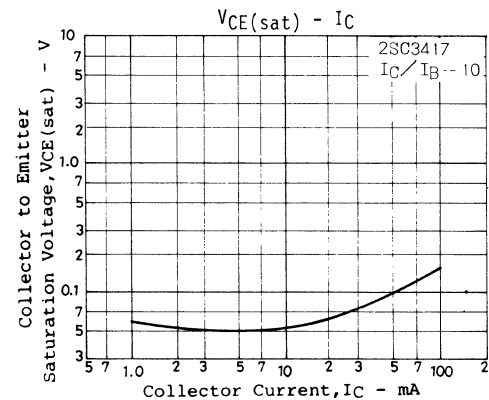
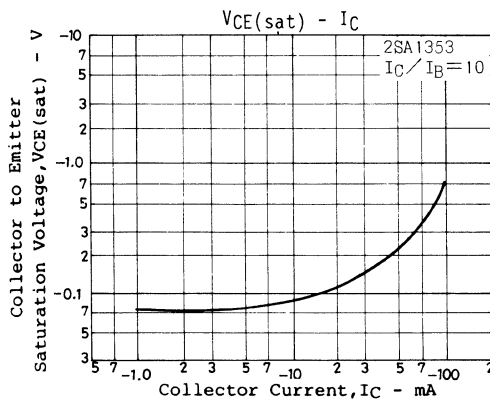
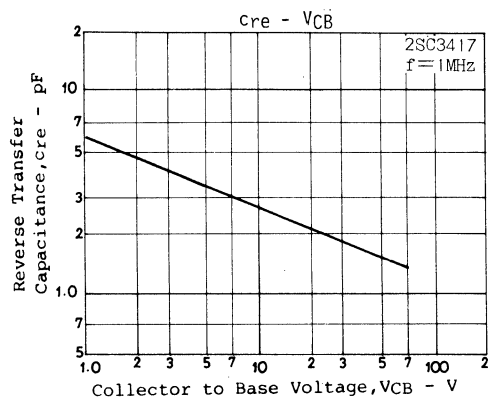
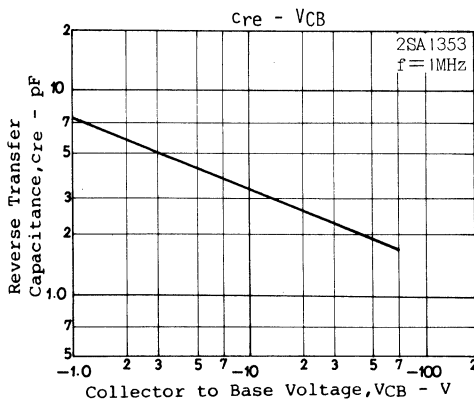
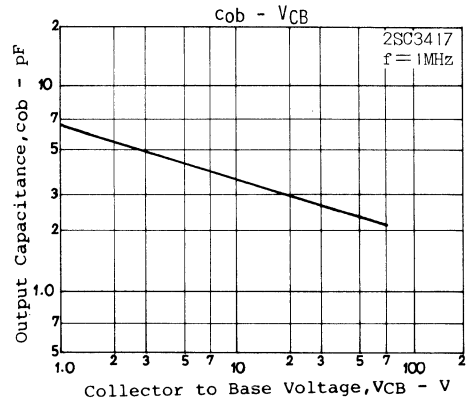
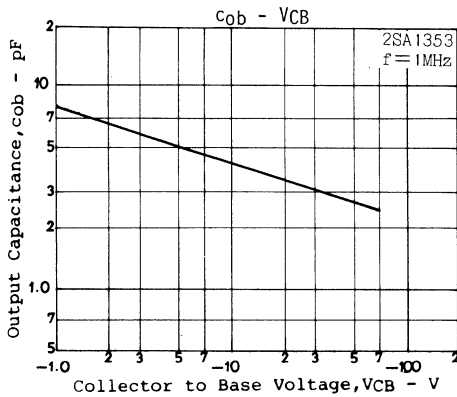
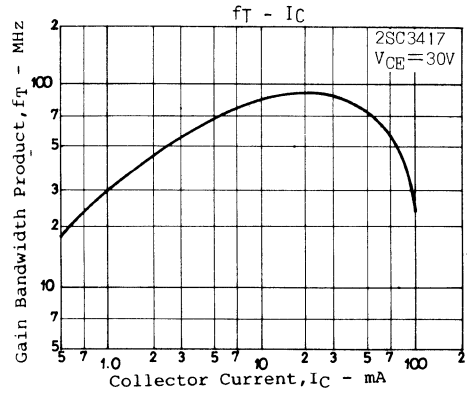
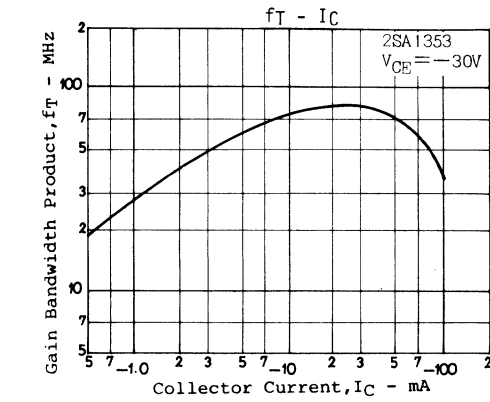
Case Outline 2009
(unit:mm)

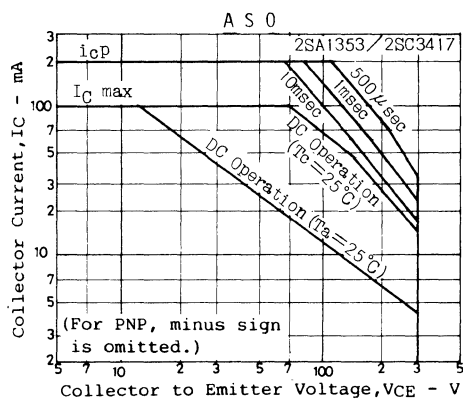
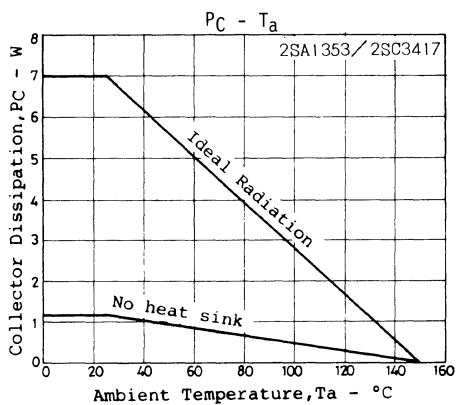
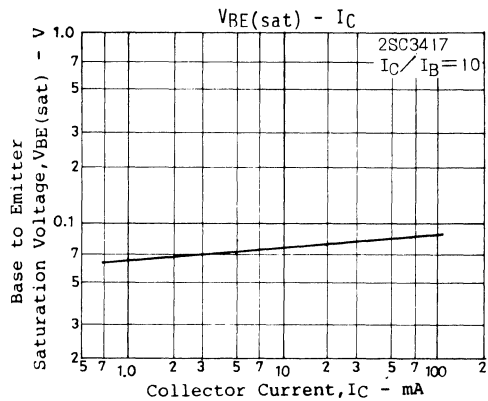
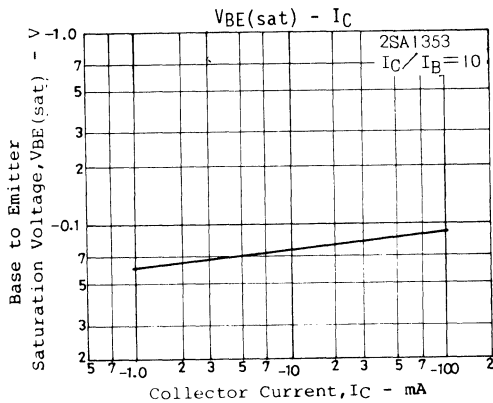


JEDEC: TO-126

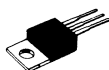
B: Base
C: Collector
E: Emitter







2SC3446



2010A

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1544A

Use

- Switching regulator

Features

- High breakdown voltage and high reliability
- Fast switching speed (t_f : 0.1us typ.)
- Wide ASO
- Adoption of MBIT process

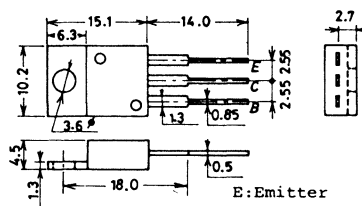
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	800	V
Collector to Emitter Voltage	V_{CE0}	500	V
Emitter to Base Voltage	V_{EB0}	7	V
Collector Current	I_C	3	A
Peak Collector Current	i_{cp}	$PW \leq 300\mu s$, Duty Cycle $\leq 10\%$	6 A
Base Current	I_B	1	A
Collector Dissipation	P_C	$T_C=25^\circ\text{C}$	40 W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=500V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=5V, I_C=0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5V, I_C=0.3A$	10			
	$h_{FE}(2)$	$V_{CE}=5V, I_C=1.5A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.3A$		18		MHz
Output Capacitance	C_{ob}	$V_{CB}=10V, f=1\text{MHz}$		50		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=1.5A, I_B=0.3A$			1.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=1.5A, I_B=0.3A$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1mA, I_E=0$	800			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=5mA, R_{BE}=\infty$	500			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1mA, I_C=0$	7			V

Case Outline 2010A (unit:mm)

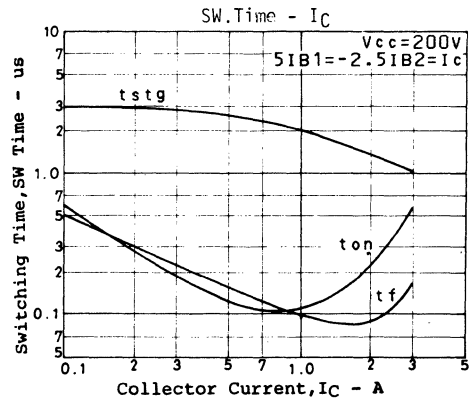
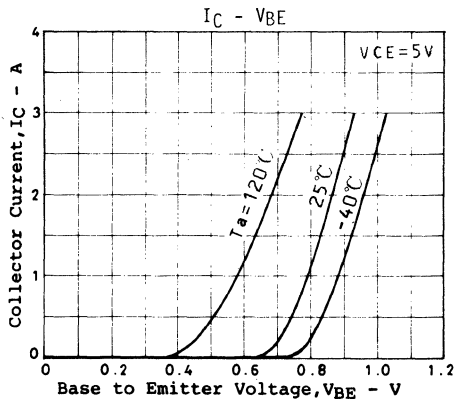
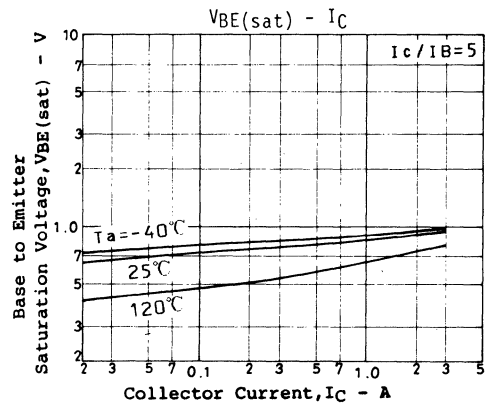
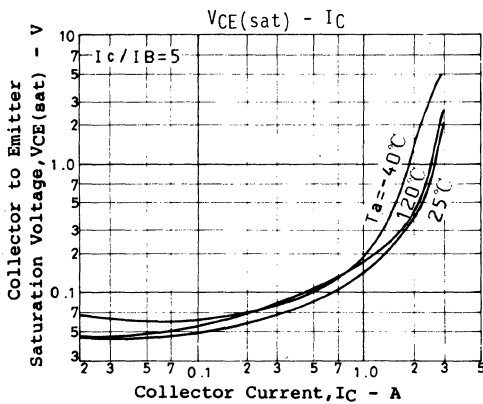
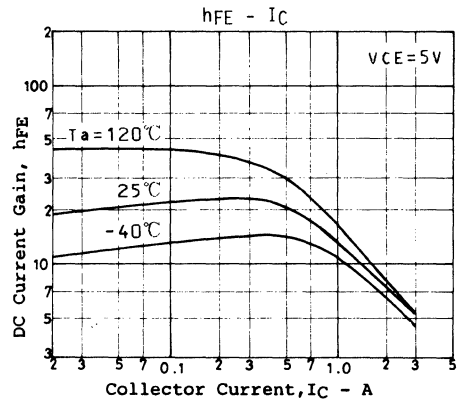
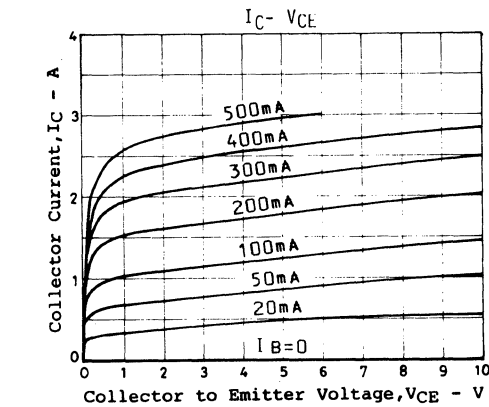
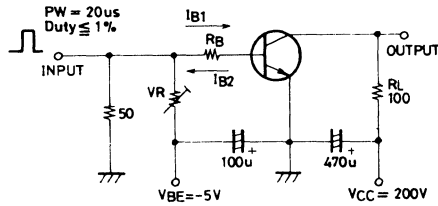


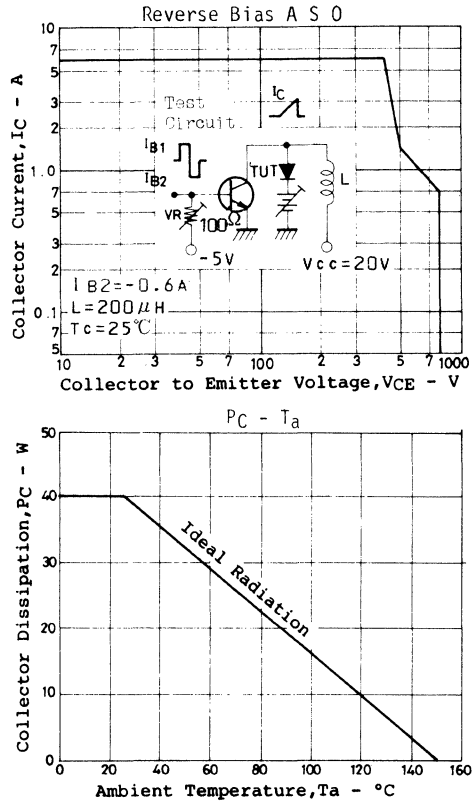
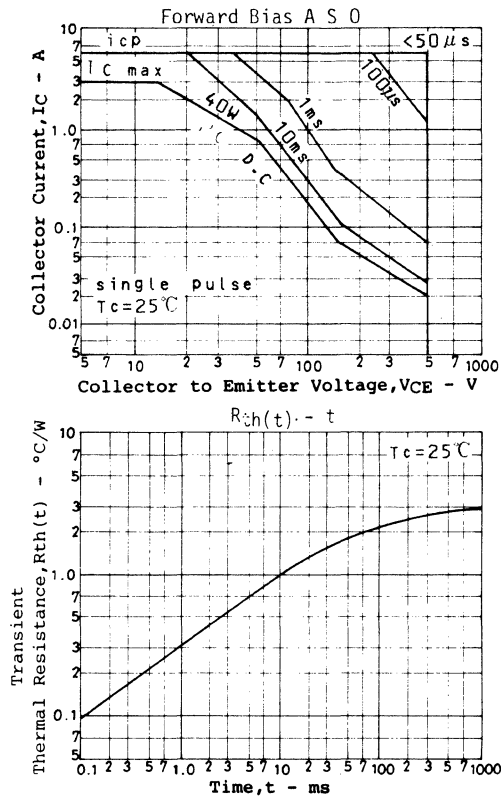
JEDEC: TO-220AB
EIAJ : SC-46

E:Emitter
C:Collector
B:Base

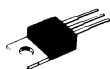
C-E Sustain Voltage	VCEX(sus)	$I_C=1.5A$	min	typ	max	unit
		$I_{B1}=-I_{B2}=0.6A,$	500			V
		$L=2mH, \text{Clamped}$				
Turn-on Time	t_{on}	$V_{CC}=200V,$			0.5	us
Storage Time	t_{stg}	$5I_{B1}=-2.5I_{B2}=I_C=2A,$			3.0	us
Fall Time	t_f	$R_L=100ohm$			0.3	us

Switching Time Test Circuit





2SC3447



2010A

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1545A

Use

- . Switching regulator

Features

- . High breakdown voltage and high reliability
- . Fast switching speed (t_f : 0.1us typ.)
- . Wide ASO
- . Adoption of MBIT process

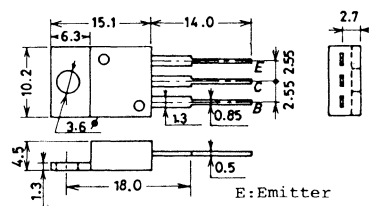
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	800	V
Collector to Emitter Voltage	V_{CE0}	500	V
Emitter to Base Voltage	V_{EB0}	7	V
Collector Current	I_C	5	A
Peak Collector Current	i_{cp}	$PW \leq 300\mu s$, Duty Cycle $\leq 10\%$	
Base Current	I_B	2	A
Collector Dissipation	P_C	$T_C=25^\circ\text{C}$	
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=500V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5V, I_C=0.6A$	10			
	$h_{FE}(2)$	$V_{CE}=5V, I_C=3A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.6A$		18		MHz
Output Capacitance	C_{ob}	$V_{CB}=10V, f=1\text{MHz}$		80		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=3A, I_B=0.6A$			1.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=3A, I_B=0.6A$			1.5	V
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C=1mA, I_E=0$	800			V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_C=5mA, R_{BE}=\infty$	500			V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E=1mA, I_C=0$	7			V
C-E Sustain Voltage	$V_{CEO(sus)}$	$I_C=5A, I_B=1A$, $L=50\mu H$	500			V

Case Outline 2010A (unit:mm)



JEDEC: TO-220AB
EIAJ : SC-46

C-E Sustain Voltage

 $V_{CEX}(sus)$ $I_C=2.5A$,
 $I_{B1}=-I_{B2}=1A$,
 $L=1mH$, Clamped

min	typ	max	unit
500			V

Turn-on Time

 t_{on} $V_{CC}=200V$,

0.5 us

Storage Time

 t_{stg} $5I_{B1}=-2.5I_{B2}=I_C=4A$,

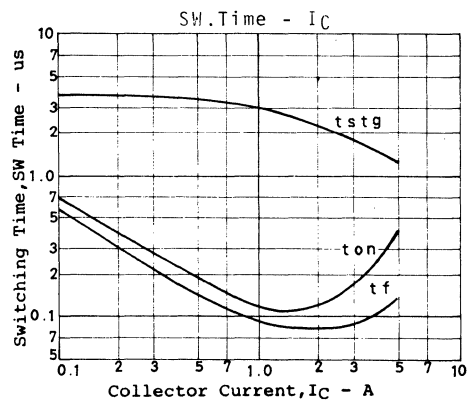
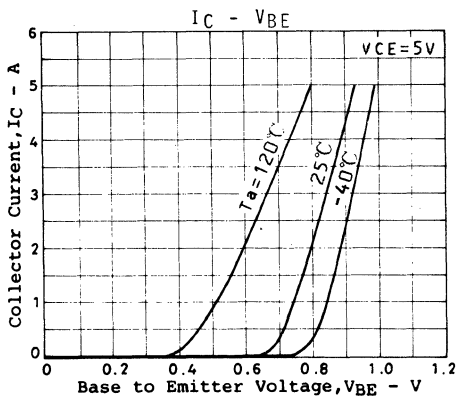
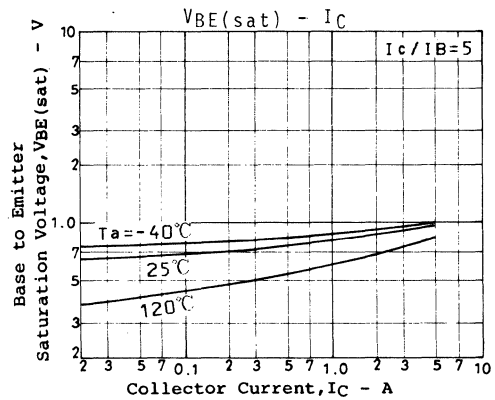
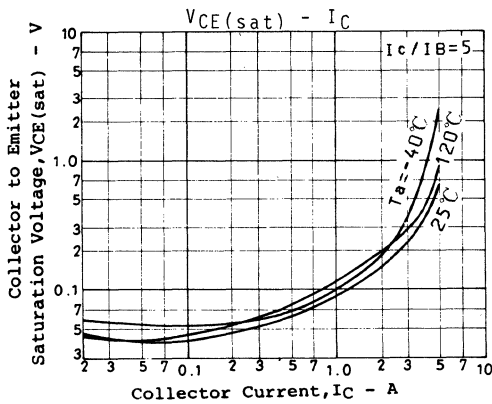
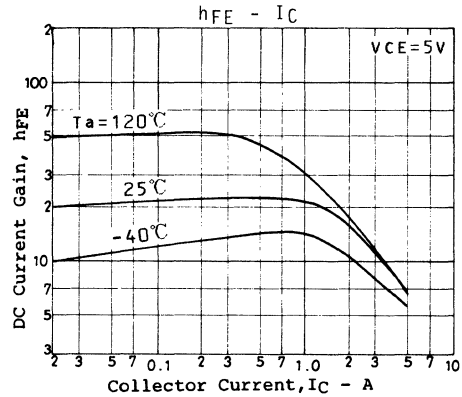
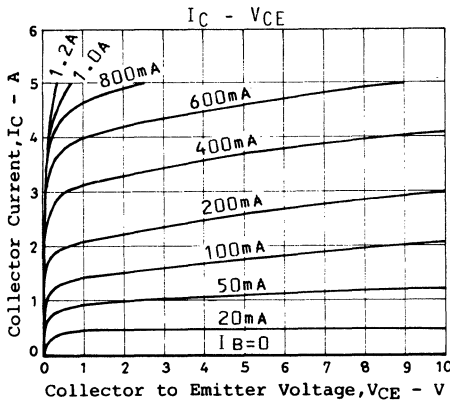
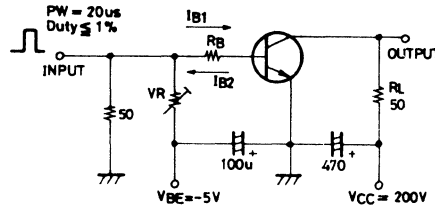
3.0 us

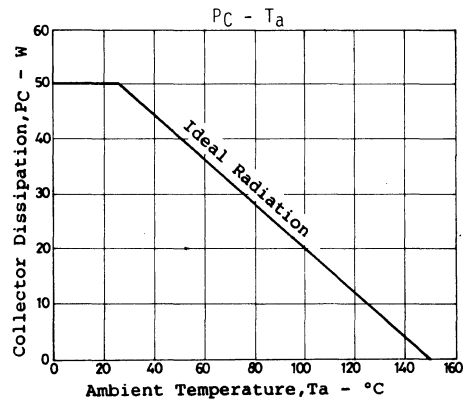
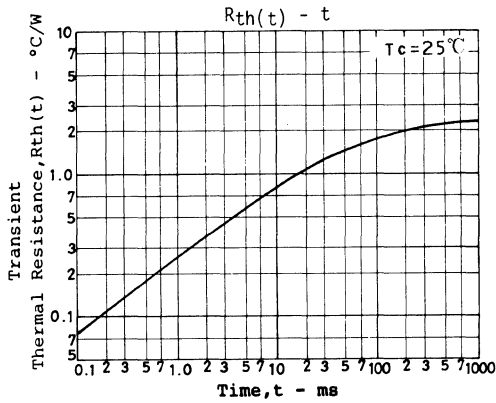
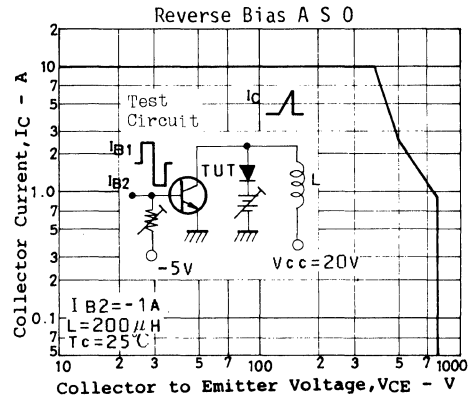
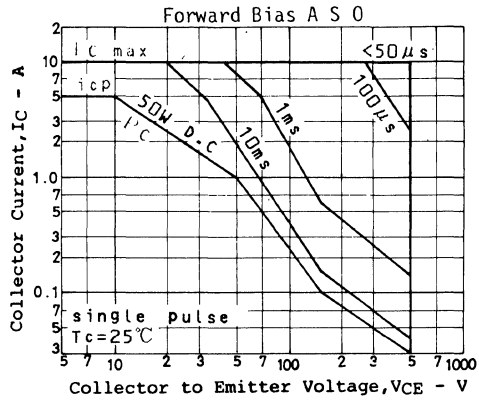
Fall Time

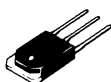
 t_f $R_L=50\Omega$

0.3 us

Switching Time Test Circuit







2022

NPN Triple Diffused Planar Silicon Transistor

Switching Regulator Applications

①1546A

Use

- . Switching regulator

Features

- High breakdown voltage and high reliability
- Fast switching speed (t_f: 0.1μs typ.)
- Wide ASO
- Adoption of MBIT process

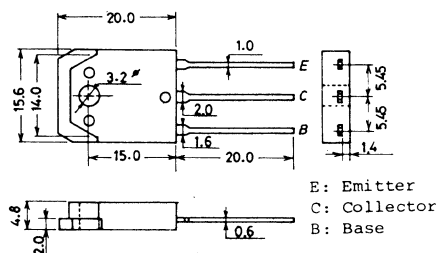
Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

Collector to Base Voltage	V _{CB0}	800	V
Collector to Emitter Voltage	V _{CE0}	500	V
Emitter to Base Voltage	V _{EB0}	7	V
Collector Current	I _C	4	A
Peak Collector Current	i _{cp} PW≤300us, Duty Cycle≤10%	8	A
Base Current	I _B	1.5	A
Collector Dissipation	P _C T _C =25°C	60	W
Junction Temperature	T _j	150	°C
Storage Temperature	T _{sta}	-55 to +150	°C

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

Electrical Characteristics at Ta=25°C			min	typ	max	unit
Collector Cutoff Current	ICBO	V _{CB} =500V, I _E =0			10	μA
Emitter Cutoff Current	IEBO	VEB=5V, I _C =0			10	μA
DC Current Gain	hFE(1)	V _{CE} =5V, I _C =0.3A	10			
	hFE(2)	V _{CE} =5V, I _C =1.5A	8			
Gain Bandwidth Product	f _T	V _{CE} =10V, I _C =0.3A		18		MHz
Output Capacitance	C _{ob}	V _{CB} =10V, f=1MHz		50		pF
C-E Saturation Voltage	V _{CE(sat)}	I _C =1.5A, I _B =0.3A			1.0	V
B-E Saturation Voltage	V _{BE(sat)}	I _C =1.5A, I _B =0.3A			1.5	V
C-B Breakdown Voltage	V(BR)CBO	I _C =1mA, I _E =0	800			V
C-E Breakdown Voltage	V(BR)CEO	I _C =5mA, R _{BE} =∞	500			V
E-B breakdown Voltage	V(BR)EBO	I _E =1mA, I _C =0	7			V
C-E Sustain Voltage	V _{CEO(sus)}	I _C =3A, I _B =0.6A, L=50μH	500			V

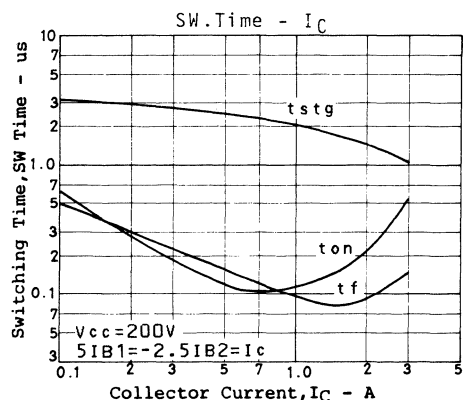
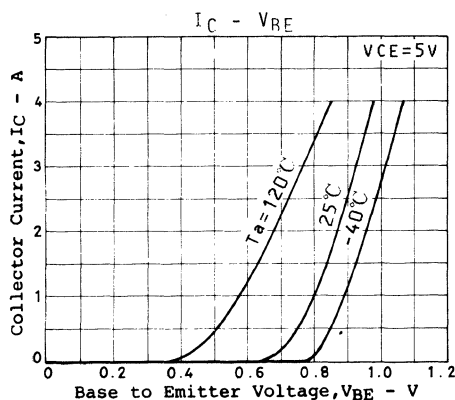
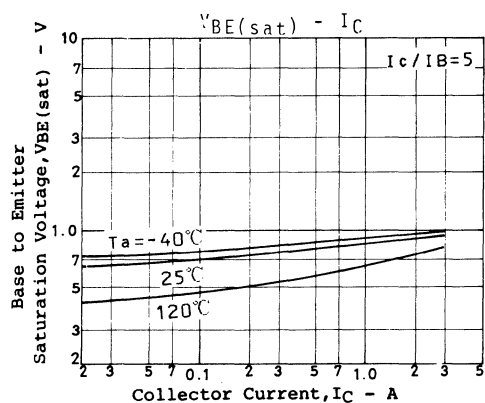
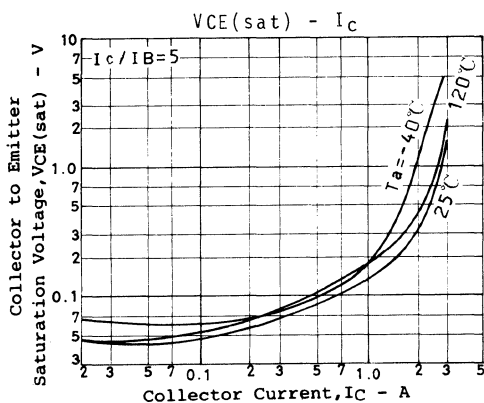
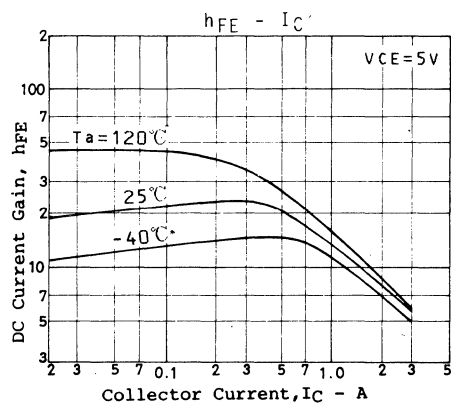
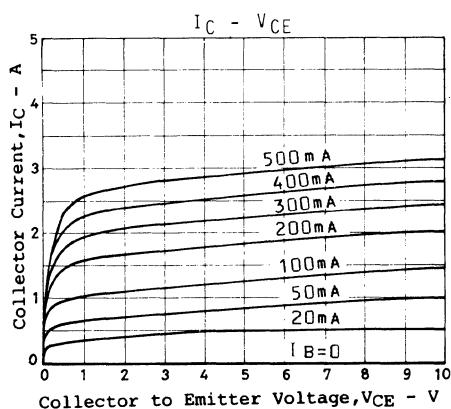
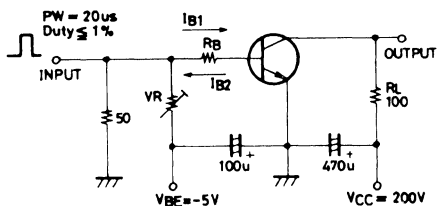
Case Outline 2022
(unit:mm)

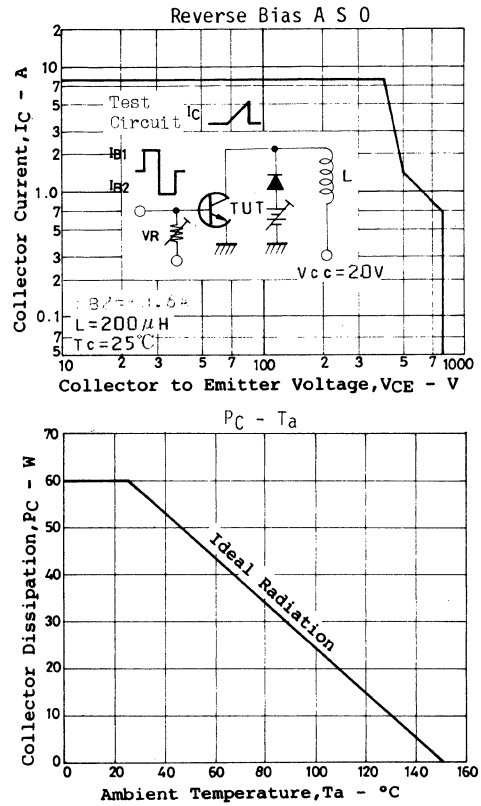
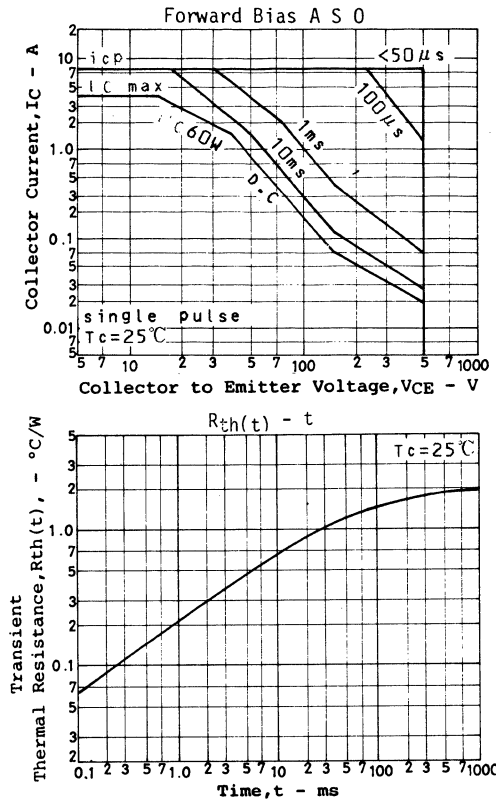


E: Emitter
C: Collector
B: Base

			min	typ	max	unit
C-E Sustain Voltage	V _{CES} (sus)	I _C =1.5A I _{B1} =-I _{B2} =0.6A, L=1mH, Clamped	500			V
Turn-on Time	t _{on}	[V _{CC} =200V, 5I _{B1} =-2.5I _{B2} =I _C =2A, R _L =100ohm]			0.5	us
Storage Time	t _{stg}				3.0	us
Fall Time	t _f				0.3	us

Switching Time Test Circuit





2SC3449



2022

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1572A

Features

- High breakdown voltage and high reliability
- Fast switching speed (t_f : 0.1us typ.)
- Wide ASO
- Adoption of MBIT process

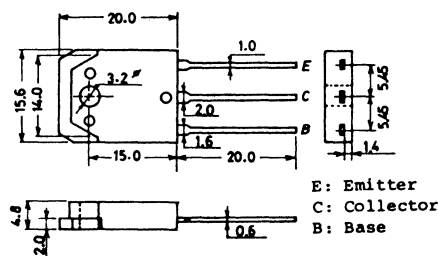
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

Absolute Maximum Ratings at Ta=25°C				unit	
Collector to Base Voltage	V _{CB0}	800		V	
Collector to Emitter Voltage	V _{CEO}	500		V	
Emitter to Base Voltage	V _{EB0}	7		V	
Collector Current	I _C	7		A	
Peak Collector Current	i _{cp}	PW≤300us, Duty Cycle≤10%		14	A
Base Current	I _B	3		A	
Collector Dissipation	P _C	T _C =25°C	80	W	
Junction Temperature	T _j	150		°C	
Storage Temperature	T _{stg}	-55 to +150		°C	

Electrical Characteristics at $T_a=25^\circ\text{C}$

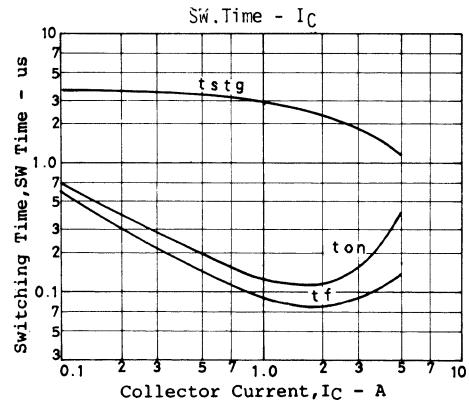
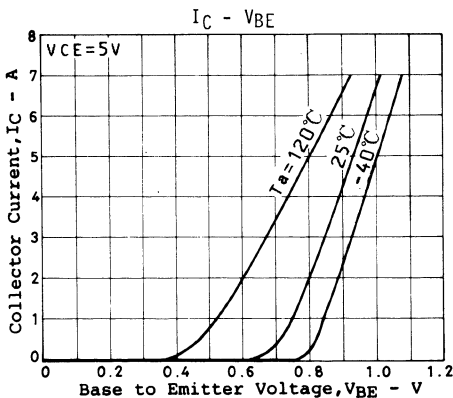
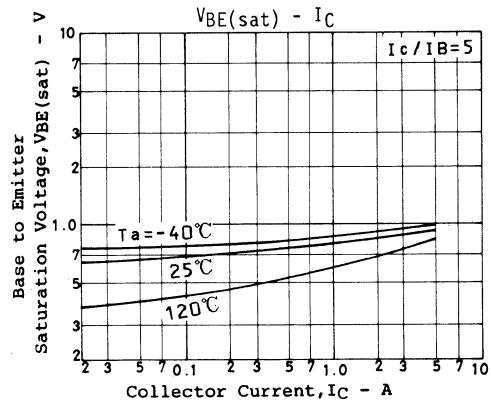
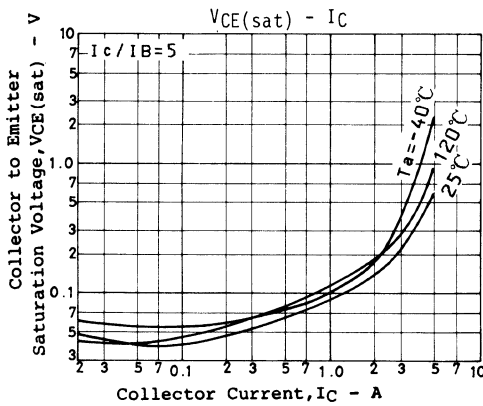
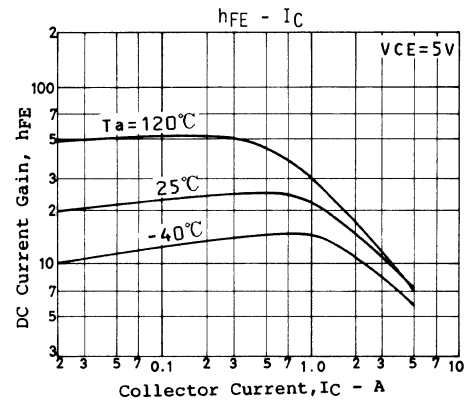
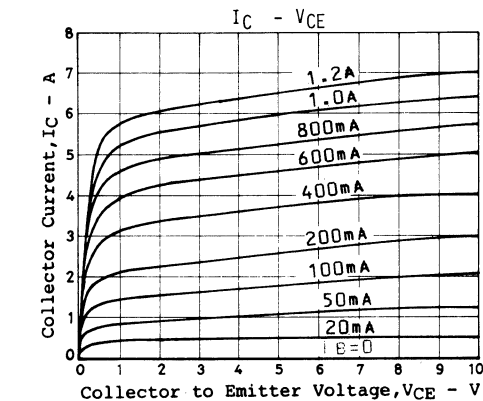
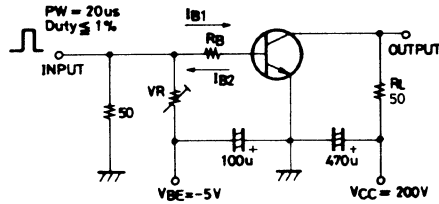
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=500V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5V, I_C=0.6A$	10			
	$h_{FE}(2)$	$V_{CE}=5V, I_C=3A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.6A$		18		MHz
Output Capacitance	C_{ob}	$V_{CB}=10V, f=1\text{MHz}$		80		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=3A, I_B=0.6A$			1.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=3A, I_B=0.6A$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1mA, I_E=0$	800			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=5mA, R_{BE}=\infty$	500			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1mA, I_C=0$	7			V

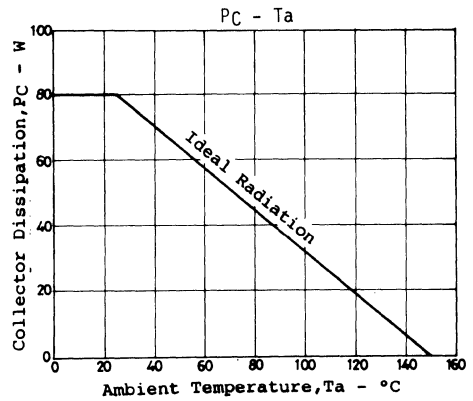
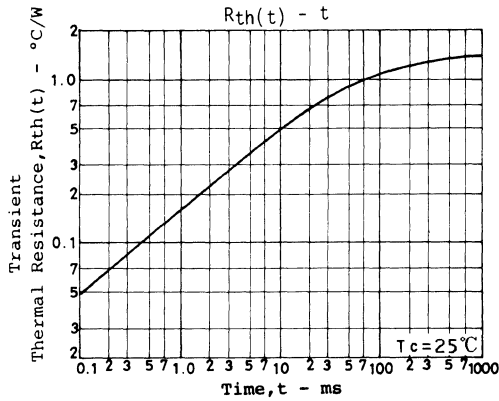
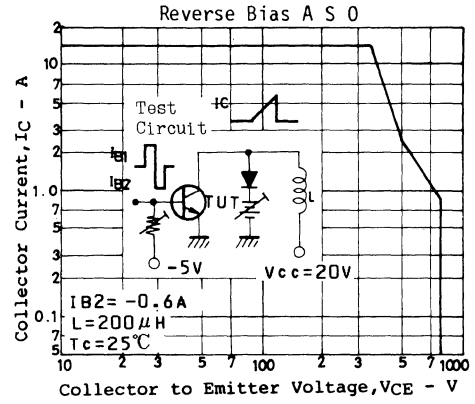
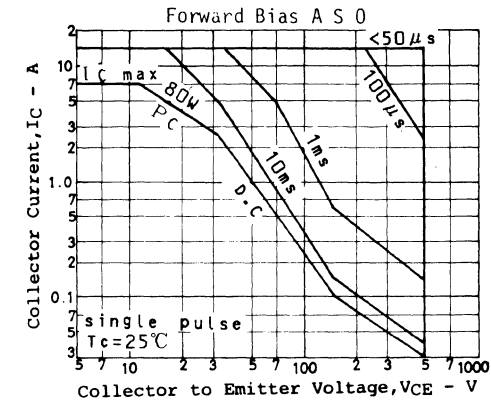
Case Outline 2022 (unit:mm)



C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C=2.5A$ $I_{B1}=-I_{B2}=1A$, $L=1mH$, Clamped	min 500	typ	max	unit V
Turn-on Time	t_{on}	$\left[\begin{array}{l} V_{CC}=200V, \\ 5I_{B1}=-2.5I_{B2}=I_C=4A, \\ R_L=50\Omega \end{array} \right]$			0.5	us
Storage Time	t_{stg}				3.0	us
Fall Time	t_f				0.3	us

Switching Time Test Circuit





2SC3450



2022

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1576A

Features

- High breakdown voltage and high reliability
- Fast switching speed (t_f : 0.1us typ.)
- Wide ASO
- Adoption of MBIT process

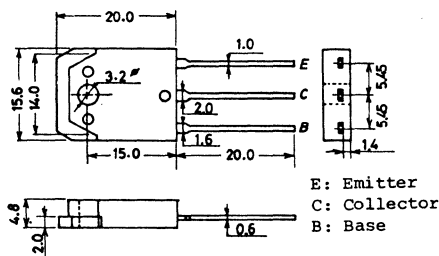
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

Solute Maximum Ratings at Ta=25°C				unit
Collector to Base Voltage	VCBO		800	V
Collector to Emitter Voltage	VCEO		500	V
Emitter to Base Voltage	VEBO		7	V
Collector Current	IC		10	A
Peak Collector Current	icp	PW≤300us, Duty Cycle≤10%	20	A
Base Current	IB		3	A
Collector Dissipation	PC	Tc=25°C	90	W
Junction Temperature	Tj		150	°C
Storage Temperature	Tstg		-55 to +150	°C

Electrical Characteristics at $T_a=25^\circ\text{C}$

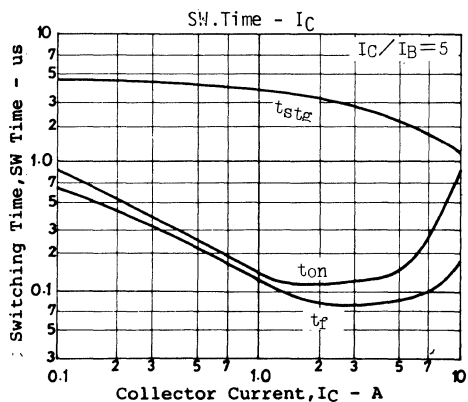
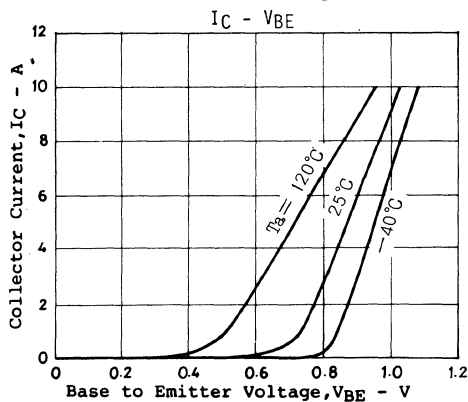
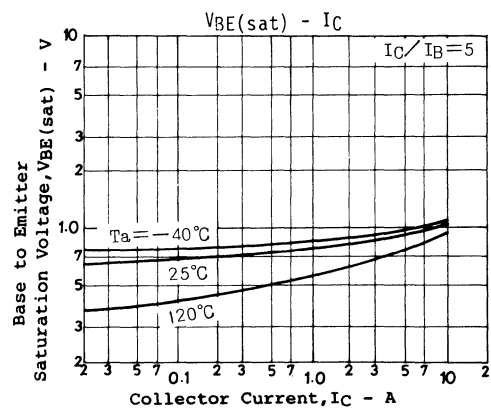
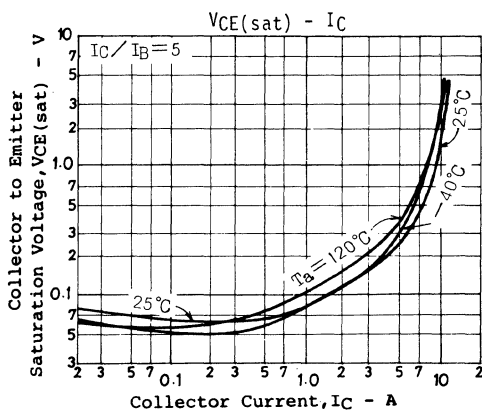
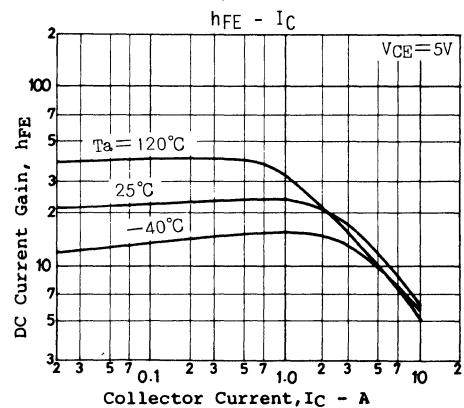
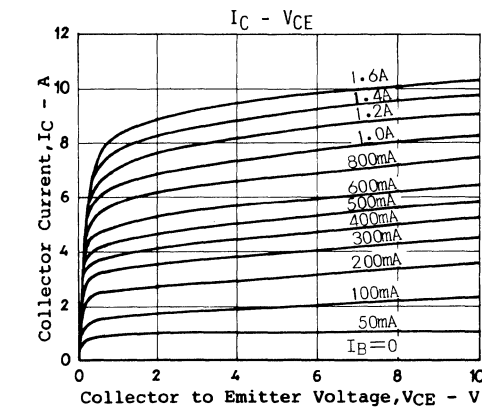
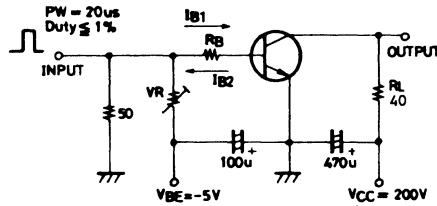
			min	typ	max	unit
Collector Cutoff Current	I _{CBO}	V _{CB} =500V, I _E =0			10	uA
Emitter Cutoff Current	I _{EB0}	V _{EB} =5V, I _C =0			10	uA
DC Current Gain	h _{FE} (1)	V _{CE} =5V, I _C =0.8A	10			
	h _{FE} (2)	V _{CE} =5V, I _C =4A	8			
Gain Bandwidth Product	f _T	V _{CE} =10V, I _C =0.8A		18		MHz
Output Capacitance	C _{ob}	V _{CB} =10V, f=1MHz		120		pF
C-E Saturation Voltage	V _{CE} (sat)	I _C =4A, I _B =0.8A			1.0	V
B-E Saturation Voltage	V _{BE} (sat)	I _C =4A, I _B =0.8A			1.5	V
C-B Breakdown Voltage	V(BR) _{CBO}	I _C =1mA, I _E =0	800			V
C-E Breakdown Voltage	V(BR) _{CEO}	I _C =5mA, R _{BE} =∞	500			V
E-B Breakdown Voltage	V(BR) _{EBO}	I _E =1mA, I _C =0	7			V

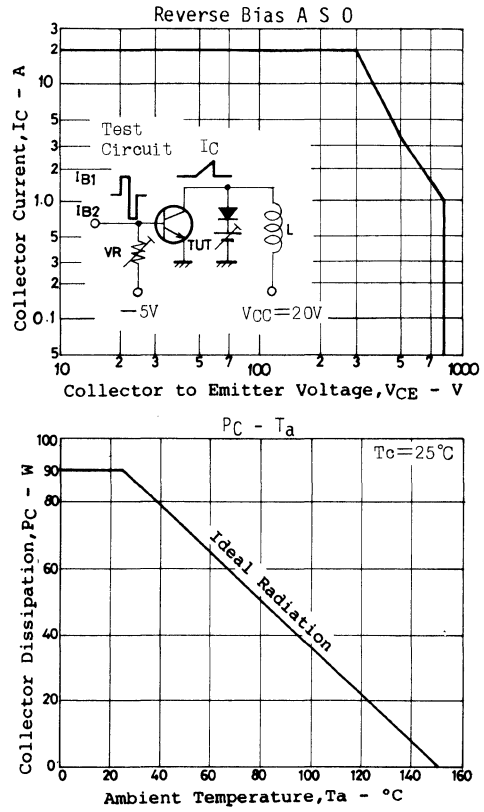
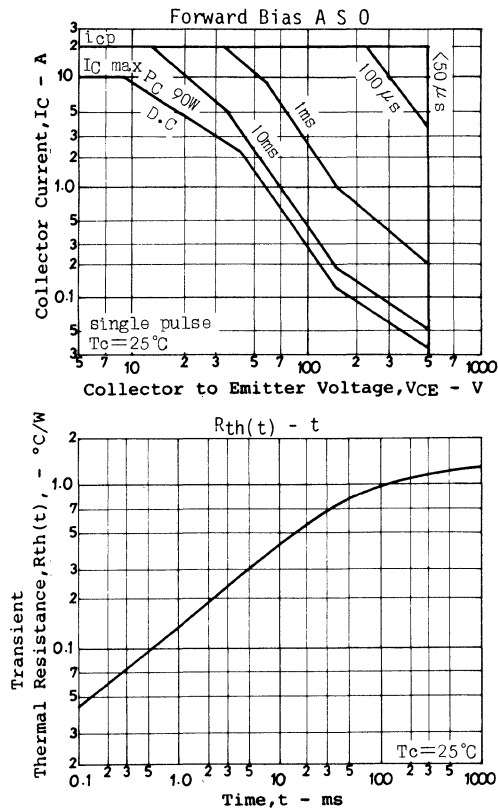
Case Outline 2022 (unit:mm)



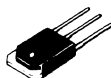
			min	typ	max	unit
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C=3.5A$ $I_{B1}=-I_{B2}=1.4A$ $L=500\mu H$, Clamped	500			V
Turn-on Time	t_{on}	$V_{CC}=200V$, $5I_{B1}=-2.5I_{B2}=I_C=5A$, $R_L=40\Omega$			0.5	us
Storage Time	t_{stg}				3.0	us
Fall Time	t_f				0.3	us

Switching Time Test Circuit





2SC3451



2022

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1577A

Features

- High breakdown voltage and high reliability
- Fast switching speed (t_f : 0.1us typ.)
- Wide ASO
- Adoption of MBIT process

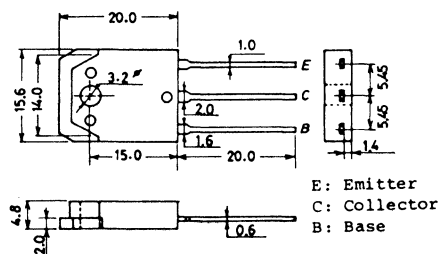
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit	
Collector to Base Voltage	V _{CB0}	800	V	
Collector to Emitter Voltage	V _{CEO}	500	V	
Emitter to Base Voltage	V _{EB0}	7	V	
Collector Current	I _C	15	A	
Peak Collector Current	i _{cp}	PW≤300us, Duty Cycle≤10%	25	A
Base Current	I _B	4	A	
Collector Dissipation	P _C	T _c =25°C	100	W
Junction Temperature	T _j		150	°C
storage Temperature	T _{stg}		-55 to +150	°C

Electrical Characteristics at $T_a=25^\circ\text{C}$

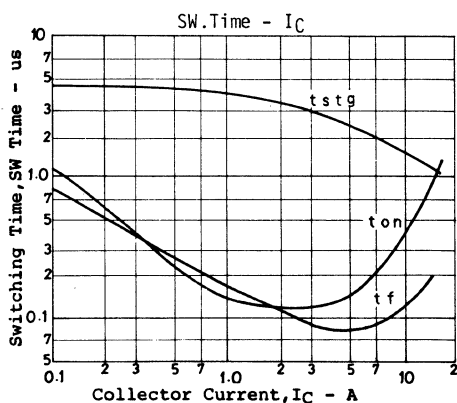
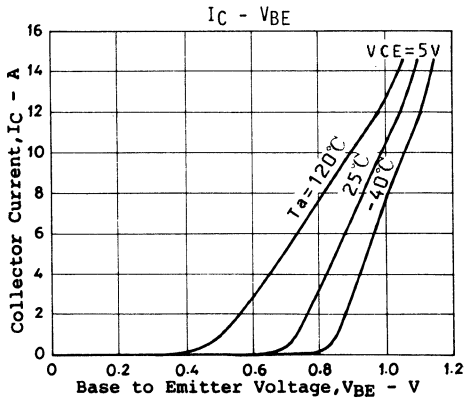
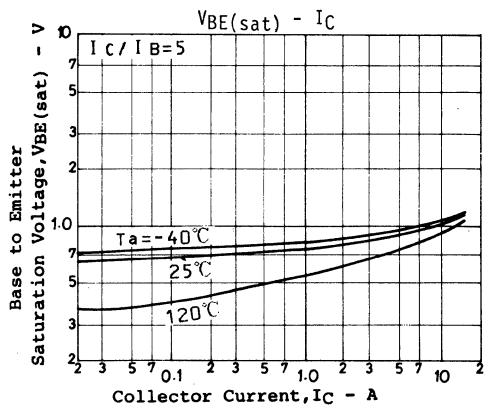
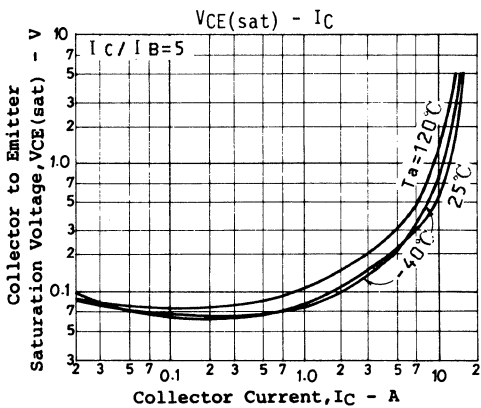
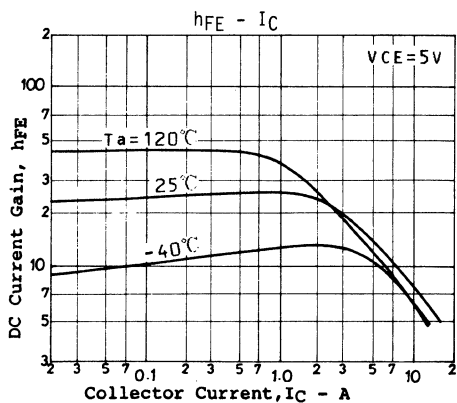
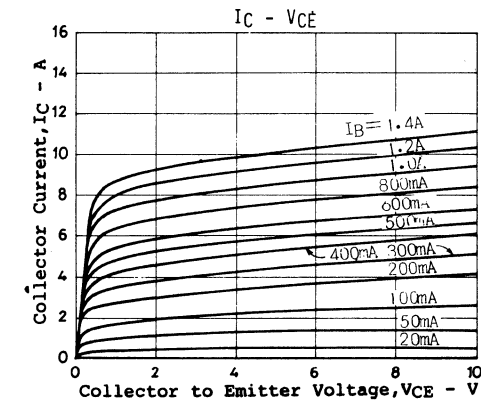
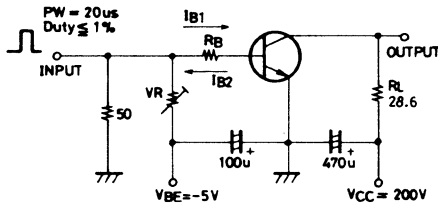
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=500V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5V, I_C=1.2A$	10			
	$h_{FE}(2)$	$V_{CE}=5V, I_C=6A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=1.2A$		18		MHz
Output Capacitance	C_{ob}	$V_{CB}=10V, f=1\text{MHz}$		160		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=6A, I_B=1.2A$			1.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=6A, I_B=1.2A$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1\text{mA}, I_E=0$	800			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=5\text{mA}, R_{BE}=\infty$	500			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1\text{mA}, I_C=0$	7			V

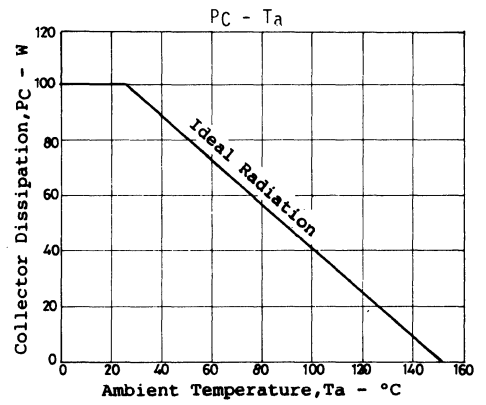
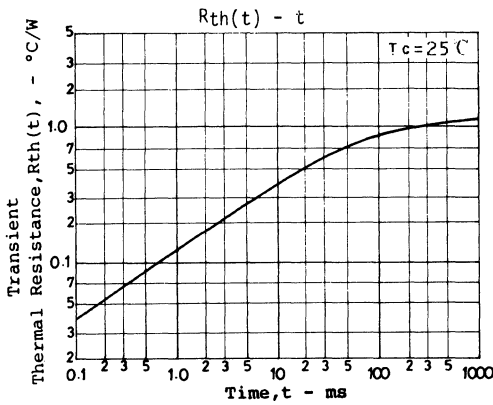
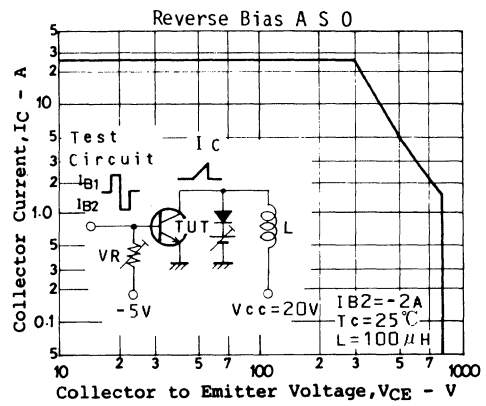
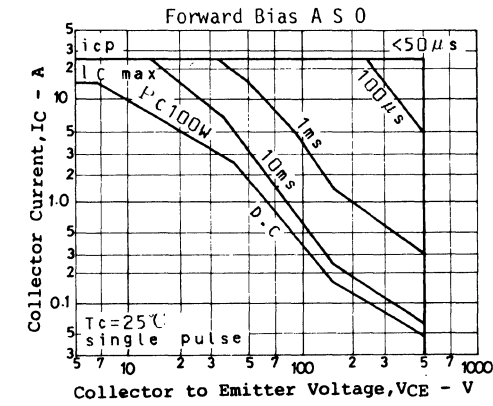
Case Outline 2022 (unit:mm)



C-E Sustain Voltage	VCEX(sus)	IC=5A, IB1=-IB2=2A, L=500uH, Clamped	min 500	typ	max	unit V
Turn-on Time	ton	VCC=200V, 5IB1=-2.5IB2=IC=7A, RL=28.6ohm			0.5	us
Storage Time	tstg				3.0	us
Fall Time	tf				0.3	us

Switching Time Test Circuit





2SC3455



2017

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1578A

Features

- High breakdown voltage and high reliability
- Fast switching speed (t_f : 0.1us typ.)
- Wide ASO
- Adoption of MBIT process

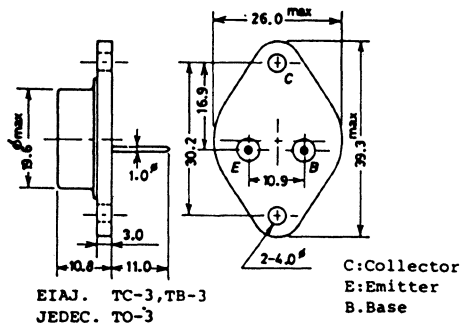
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	800	V
Collector to Emitter Voltage	V_{CEO}	500	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_C	25	A
Peak Collector Current	i_{cp}	$PW \leq 300\mu s$, Duty Cycle $\leq 10\%$	
		40	A
Base Current	I_B	8	A
Collector Dissipation	P_C	$T_c=25^\circ\text{C}$	
		160	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=500V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5V, I_C=2.4A$	10			
	$h_{FE}(2)$	$V_{CE}=5V, I_C=12A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=2.4A$		18		MHz
Output Capacitance	C_{ob}	$V_{CB}=10V, f=1\text{MHz}$		320		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=12A, I_B=2.4A$			1.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=12A, I_B=2.4A$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1\text{mA}, I_E=0$	800			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=5\text{mA}, R_{BE}=\infty$	500			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1\text{mA}, I_C=0$	7			V

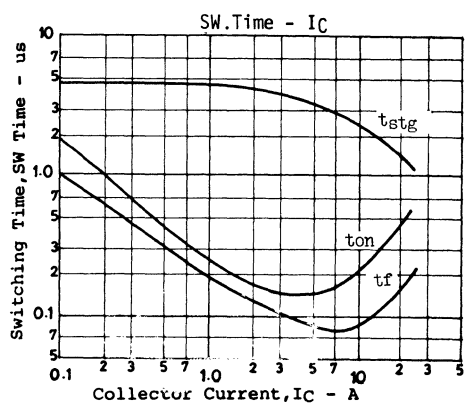
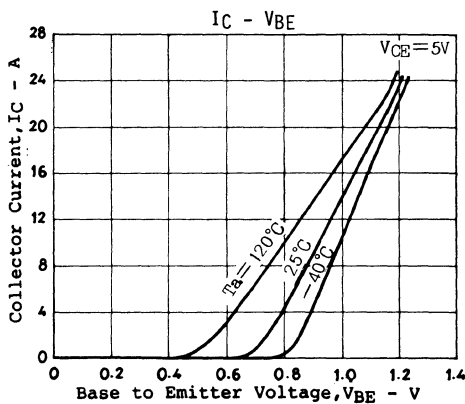
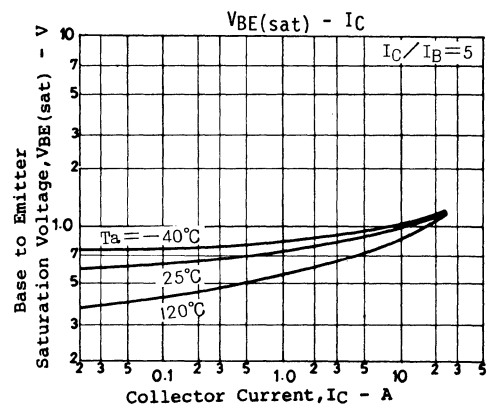
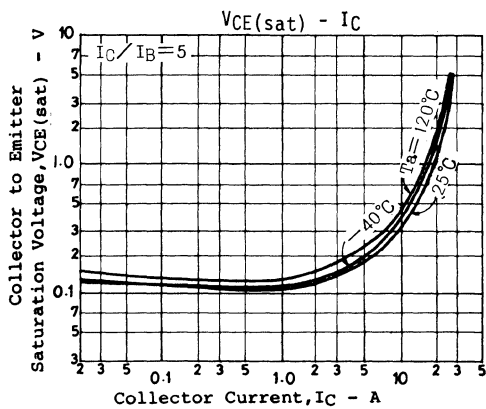
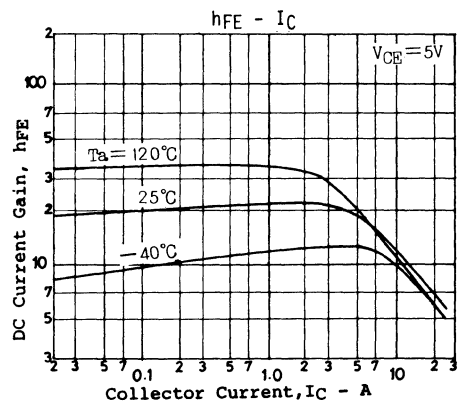
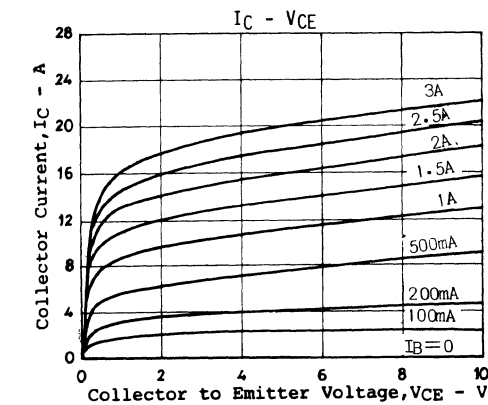
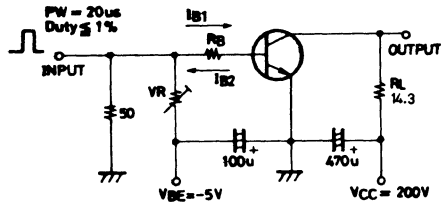
Case Outline 2017 (unit:mm)

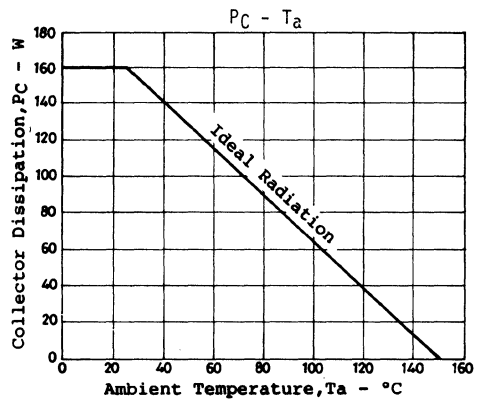
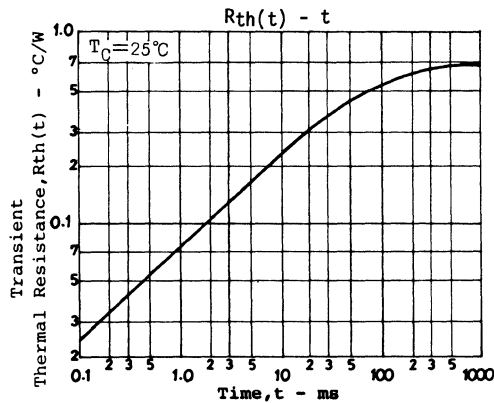
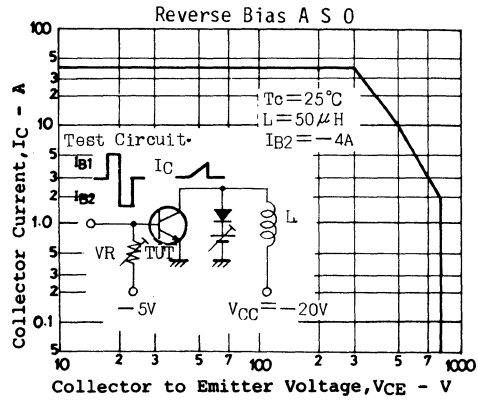
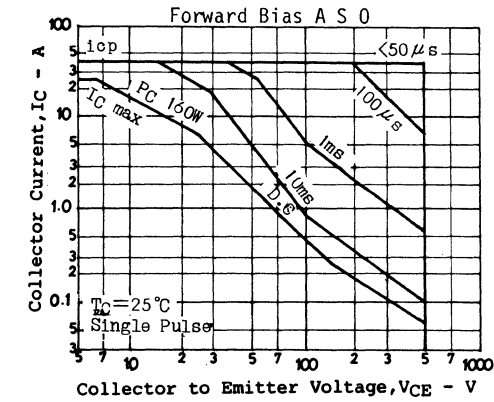


3085KI/6154KI, MT No.1578-1/3

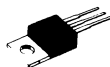
			min	typ	max	unit
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C=10A,$ $I_{B1}=-I_{B2}=4A,$ $L=200\mu H, \text{Clamped}$	500			V
Turn-on Time	t_{on}	$\left[\begin{array}{l} V_{CC}=200V, \\ 5I_{B1}=-2.5I_{B2}=I_C=14A, \\ R_L=14.3\Omega \end{array} \right]$			0.5	us
Storage Time	t_{stg}				3.0	us
Fall Time	t_f				0.3	us

Switching Time Test Circuit





2SC3456



2010A

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1579A

Features

- . High breakdown voltage and high reliability.
- . Fast switching speed (t_f : 0.1 μ s typ).
- . Wide ASO.
- . Adoption of MBIT process.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

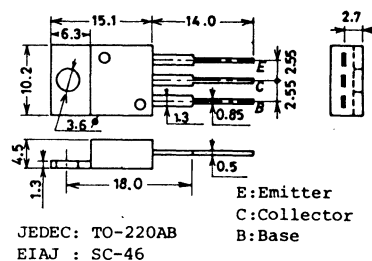
Absolute Maximum Ratings at Ta=25°C				unit
Collector to Base Voltage	V _{CB0}	1100	V	
Collector to Emitter Voltage	V _{CE0}	800	V	
Emitter to Base Voltage	V _{EB0}	7	V	
Collector Current	I _C	1.5	A	
Peak Collector Current	i _{cp}	PW≤300us,Duty Cycle≤10% 5 A		
Base Current	I _B	8	A	
Collector Dissipation	P _C	Tc=25°C 40 W		
Junction Temperature	T _j	150	°C	
Storage Temperature	T _{stg}	-55 to +150 °C		

Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=800\text{V}, I_E=0$			10	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=5\text{V}, I_C=0$			10	μA
DC Current Gain	$h_{FE(1)}$	$V_{CE}=5\text{V}, I_C=0.1\text{A}$	10			
	$h_{FE(2)}$	$V_{CE}=5\text{V}, I_C=0.5\text{A}$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=0.1\text{A}$		15		MHz
Output Capacitance	C_{ob}	$V_{CB}=10\text{V}, f=1\text{MHz}$		35		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=0.75\text{A}, I_B=0.15\text{A}$			2.0	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=0.75\text{A}, I_B=0.15\text{A}$			1.5	V
Collector to Base Breakdown Voltage	$V_{(BR)CB0}$	$I_C=1\text{mA}, I_E=0$	1100			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CE0}$	$I_C=5\text{mA}, R_{BE}=\infty$	800			V
Emitter to Base Breakdown Voltage	$V_{(BR)EB0}$	$I_E=1\text{mA}, I_C=0$	7			V

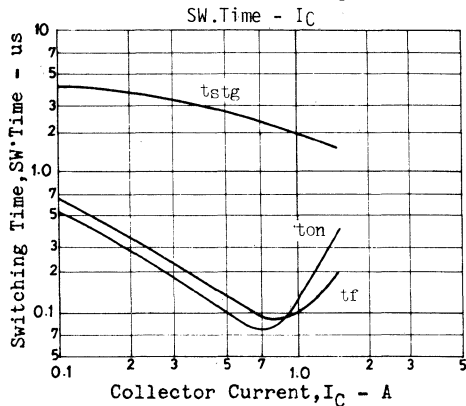
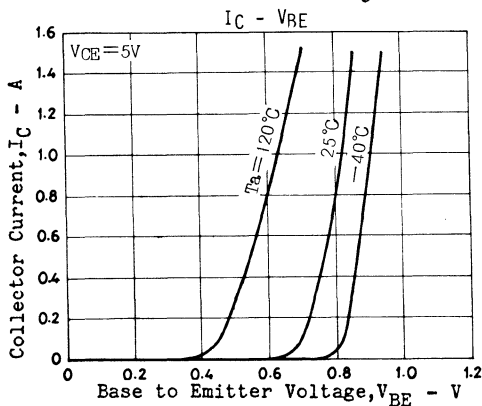
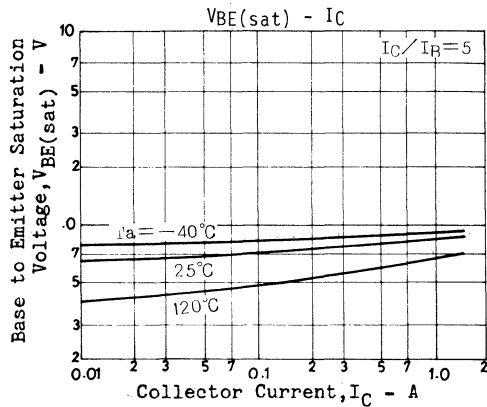
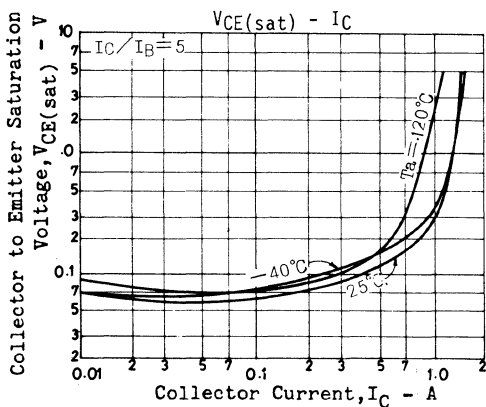
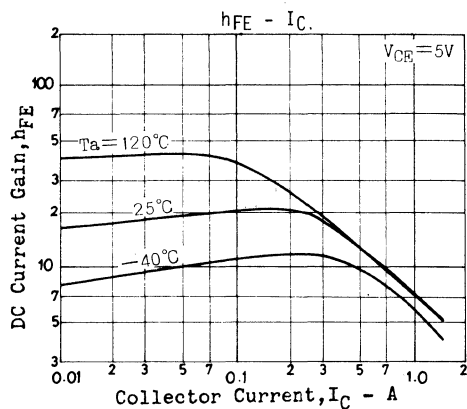
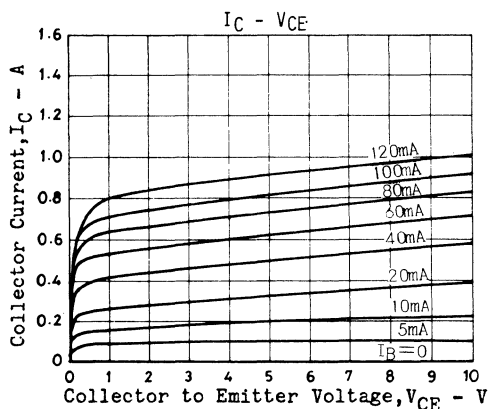
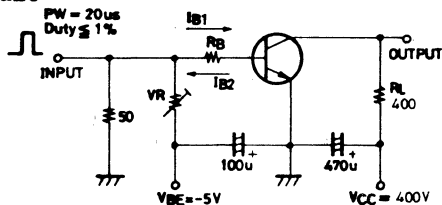
Case Outline 2010A

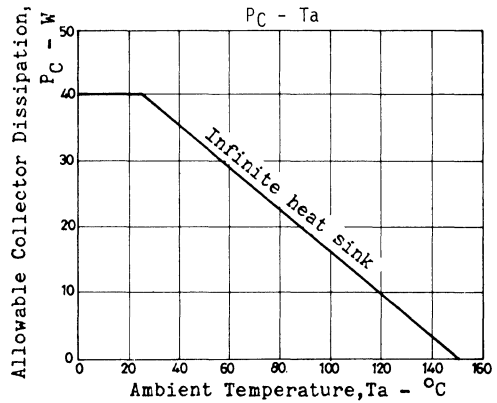
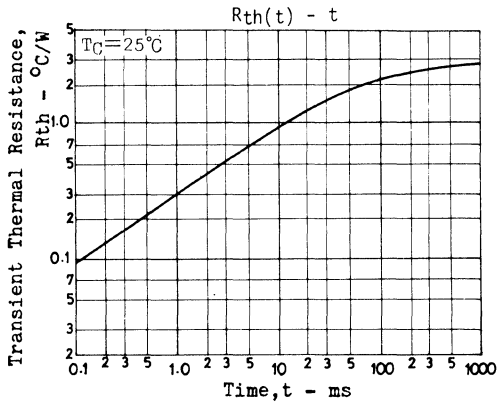
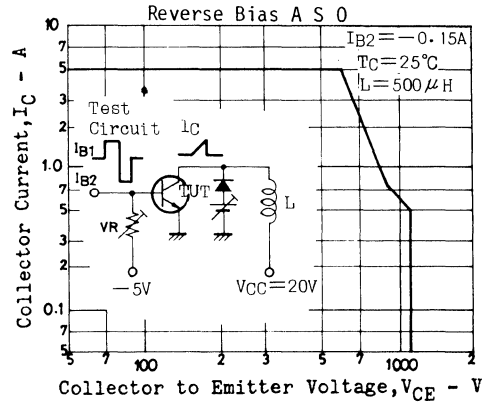
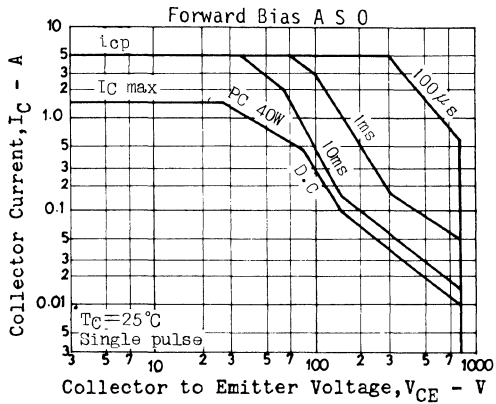
(unit:mm)



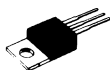
			min	typ	max	unit
Collector to Emitter Sustain Voltage	$V_{CEX(sus)}$	$I_C=0.75A$ $I_{B1}=-I_{B2}=0.15A$ $L=5mH, C \text{ clamped}$	900			V
Turn-on Time	t_{on}	$V_{CC}=400V$			0.5	us
Fall Time	t_{stg}	$5I_{B1}=-2.5I_{B2}=I_C=1A$			3.0	us
Storage Time	t_f	$R_L=400\Omega$			0.3	us

Switching Time Test Circuit





2SC3457



2010A

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1580A

Features

- High breakdown voltage and high reliability.
- Fast switching speed (tf: 0.1us typ).
- Wide ASO.
- Adoption of MBIT process.

Absolute Maximum Ratings at Ta=25°C

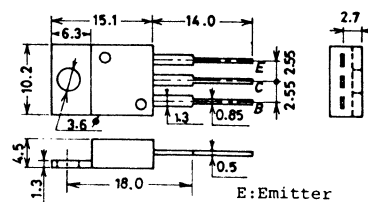
Absolute Maximum Ratings at Ta=25°C				unit
Collector to Base Voltage	V _{CBO}	1100		V
Collector to Emitter Voltage	V _{CEO}	800		V
Emitter to Base Voltage	V _{EBO}	7		V
Collector Current	I _C	3		A
Peak Collector Current	i _{cp}	PW≤300us,Duty Cycle≤10%		10
Base Current	I _B	1.5		A
Collector Dissipation	P _C	Tc=25°C		50
Junction Temperature	T _j	150		°C
Storage Temperature	T _{stg}	-55 to +150		°C

Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800V, I_E=0$			10	uA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			10	uA
DC Current Gain	$h_{FE(1)}$	$V_{CE}=5V, I_C=0.2A$	10			
	$h_{FE(2)}$	$V_{CE}=5V, I_C=1A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.2A$		15		MHz
Output Capacitance	C_{ob}	$V_{CB}=10V, f=1MHz$		60		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=1.5A, I_B=0.3A$			2.0	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=1.5A, I_B=0.3A$			1.5	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1mA, I_E=0$	1100			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=5mA, R_{BE}=\infty$	800			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1mA, I_C=0$	7			V

Case Outline 2010A

(unit:mm)

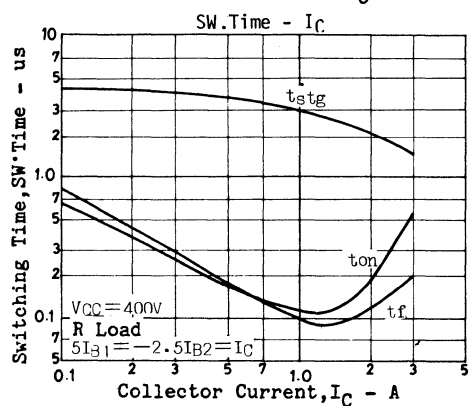
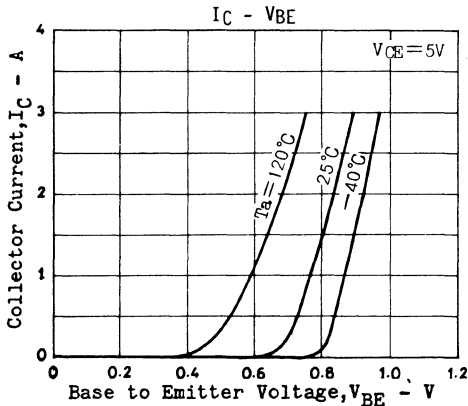
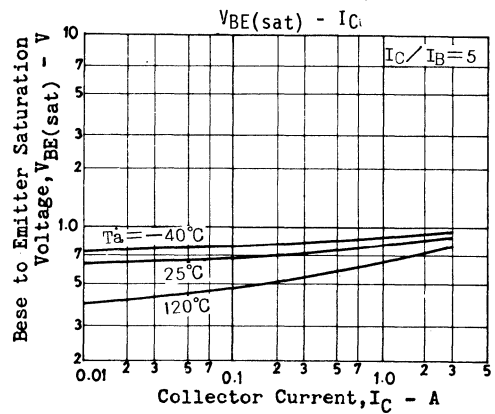
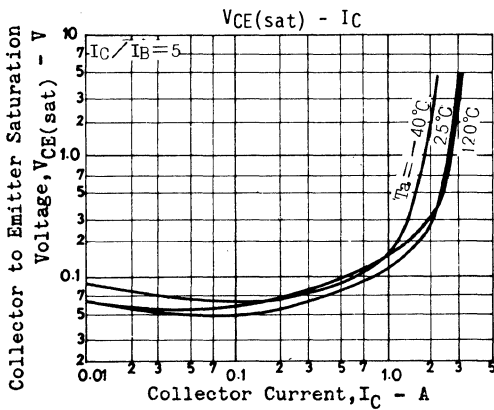
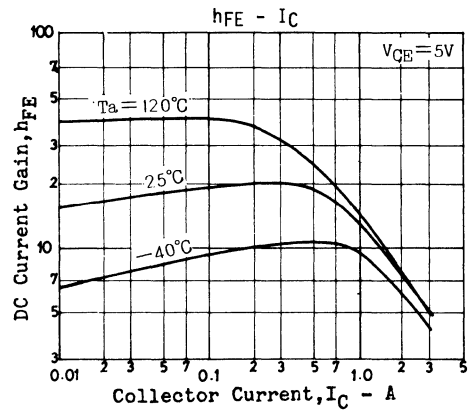
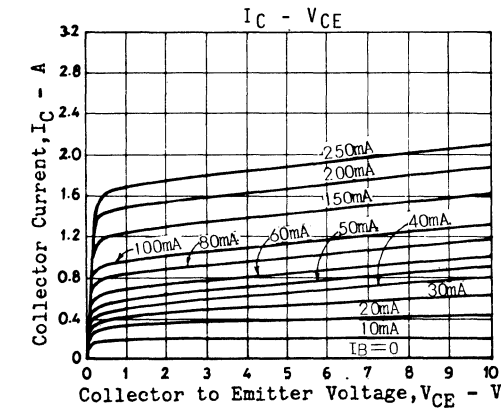
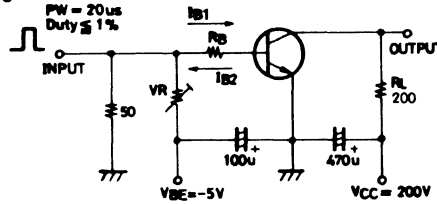


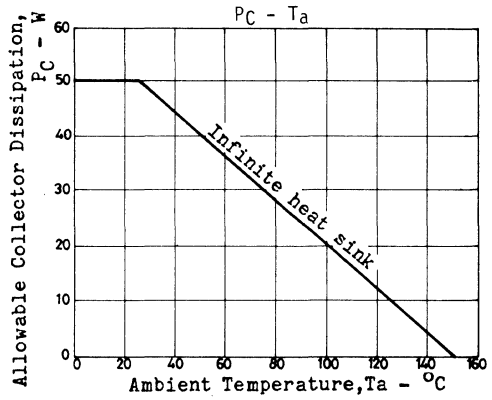
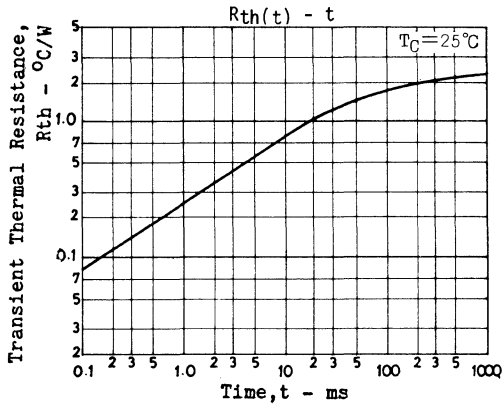
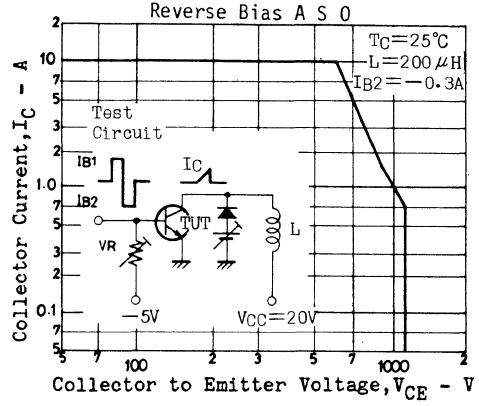
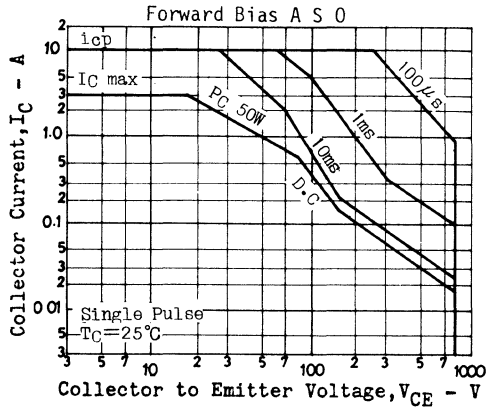
JEDEC: TO-220AB
EIAJ: SC-46

E: Emitter
C: Collector
B: Base

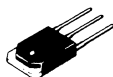
			min	typ	max	unit
Collector to Emitter Sustain Voltage	$V_{CEX(sus)}$	$I_C = 1.5A$ $I_{B1} = -I_{B2} = 0.3A$ $L = 2mH, C_{lamped}$	900			V
Turn-on Time	t_{on}	$V_{CC} = 400V$ $5I_{B1} = -2.5I_{B2} = I_C = 2A$ $R_L = 200ohm$		0.5		us
Fall Time	t_{stg}			3.0		us
Storage Time	t_f			0.3		us

Switching Time Test Circuit





2SC3458



2022

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1589A

Features

- . High breakdown voltage and high reliability.
- . Fast switching speed (t_f : 0.1us typ.)
- . Wide ASO.
- . Adoption of MBIT process.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

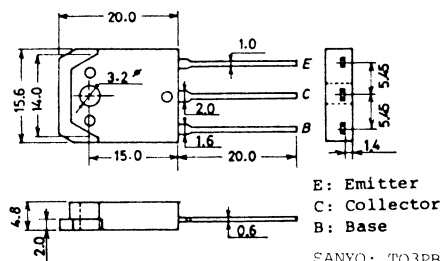
Absolute Maximum Ratings at Ta=25°C			unit
Collector to Base Voltage	V _{CB0}	1100	V
Collector to Emitter Voltage	V _{CE0}	800	V
Emitter to Base Voltage	V _{EB0}	7	V
Collector Current	I _C	3	A
Peak Collector Current	i _{cp}	PW≤300us,Duty Cycle≤10%	10
Base Current	I _B		1.5 A
Collector Dissipation	P _C	T _C =25°C	80 W
Junction Temperature	T _J		150 °C
Storage Temperature	T _{stg}		-55 to +150 °C

Electrical Characteristics at $T_a=25^\circ\text{C}$

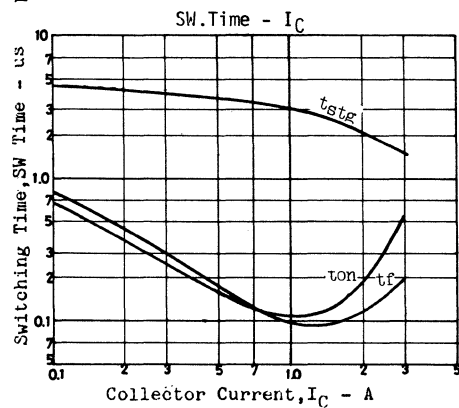
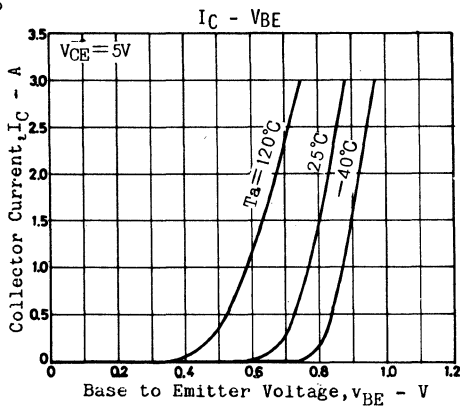
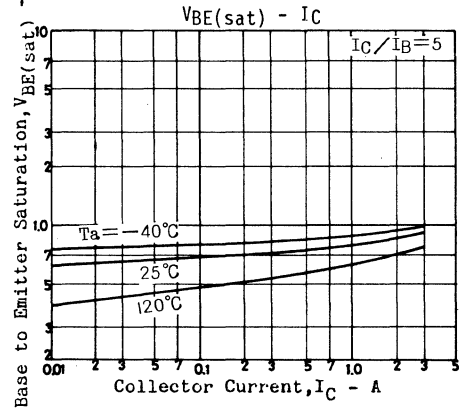
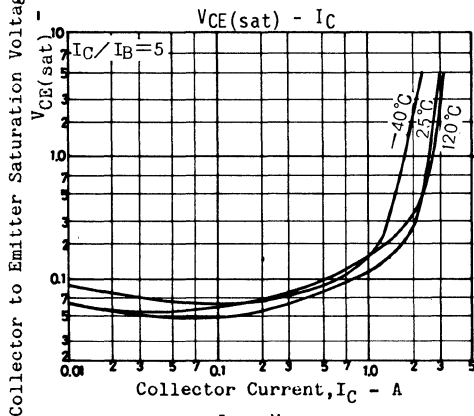
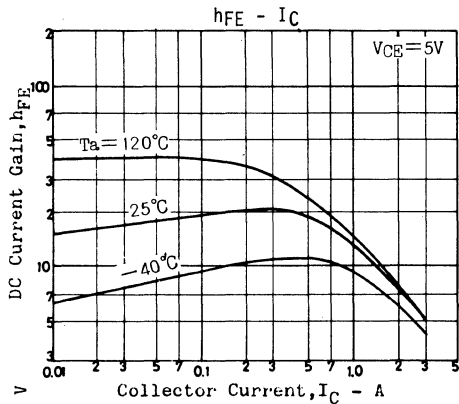
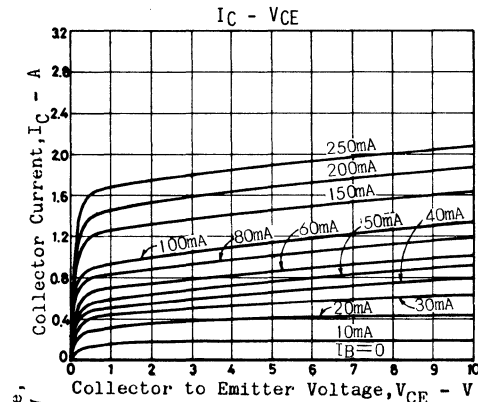
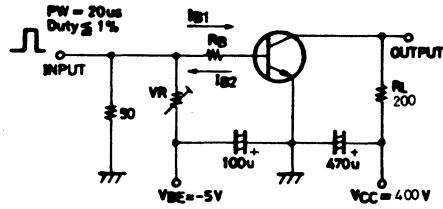
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5V, I_C=0.2A$	10			
	$h_{FE}(2)$	$V_{CE}=5V, I_C=1A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.2A$		15		MHz
Output Capacitance	c_{ob}	$V_{CB}=10V, f=1\text{MHz}$		60		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=1.5A, I_B=0.3A$			2.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=1.5A, I_B=0.3A$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1mA, I_E=0$	1100			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=5mA, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1mA, I_C=0$	7			V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C=1.5A$	900			V
		$I_{B1}=-I_{B2}=0.3A,$				
		$L=2mH, \text{Clamped}$				
Turn-On Time	t_{on}	$V_{CC}=400V,$			0.5	us
Storage Time	t_{stg}	$5I_{B2}=-2.5I_{B2}=I_C=2A,$			3.0	us
Fall Time	t_f	$R_L=200\Omega$			0.3	us

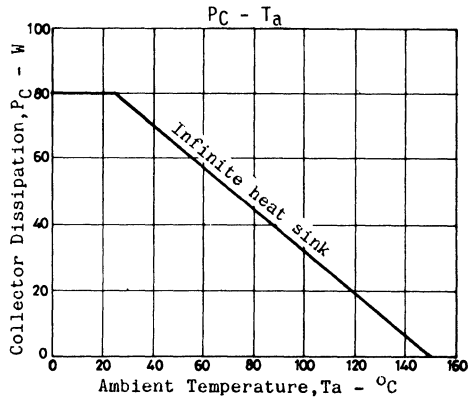
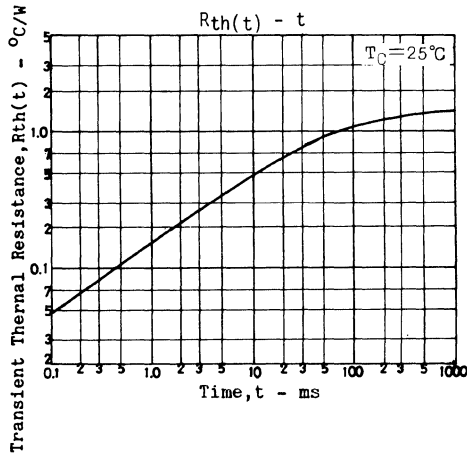
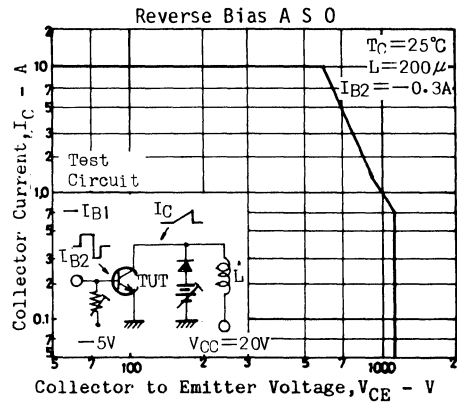
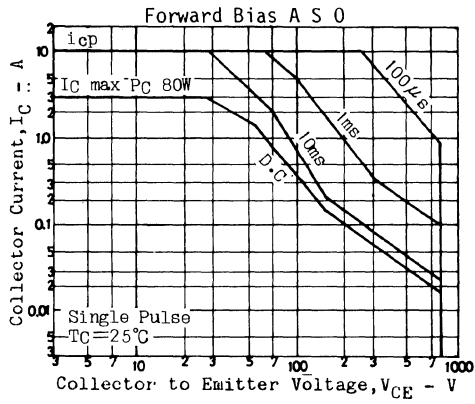
Case Outline 2022

(unit:mm)



Switching Time Test Circuit





2SC3459



2022

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1591B

Features

- High breakdown voltage and high reliability.
- Fast switching speed (t_f : 0.1us typ.)
- Wide ASO.
- Adoption of MBIT process.

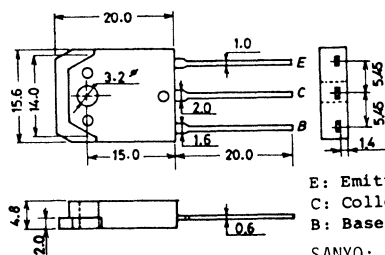
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	1100	V
Collector to Emitter Voltage	V_{CE0}	800	V
Emitter to Base Voltage	V_{EB0}	7	V
Collector Current	I_C	4.5	A
Peak Collector Current	i_{cp}	15	A
Base Current	I_B	2	A
Collector Dissipation	P_C	90	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=800\text{V}, I_E=0$			10	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=5\text{V}, I_C=0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5\text{V}, I_C=0.3\text{A}$	10			
	$h_{FE}(2)$	$V_{CE}=5\text{V}, I_C=1.5\text{A}$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=0.3\text{A}$		15		MHz
Output Capacitance	c_{ob}	$V_{CB}=10\text{V}, f=1\text{MHz}$		90		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=2\text{A}, I_B=0.4\text{A}$			2.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=2\text{A}, I_B=0.4\text{A}$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CB0}$	$I_C=1\text{mA}, I_E=0$	1100			V
C-E Breakdown Voltage	$V_{(BR)CE0}$	$I_C=5\text{mA}, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EB0}$	$I_E=1\text{mA}, I_C=0$	7			V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C=2\text{A}$	800			V
Turn-On Time	t_{on}	$I_{B1}=-I_{B2}=0.4\text{A},$ $L=2\text{mH}, \text{Clamped}$			0.5	us
Storage Time	t_{stg}	$V_{CC}=400\text{V},$ $5I_{B2}=-2.5I_{B1}, I_{B2}=I_C=3\text{A},$			3.0	us
Fall Time	t_f	$R_L=133\text{ohm}$			0.3	us

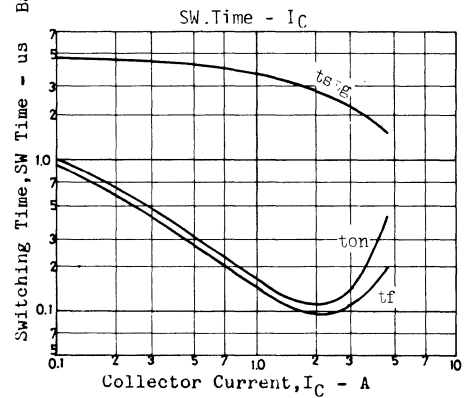
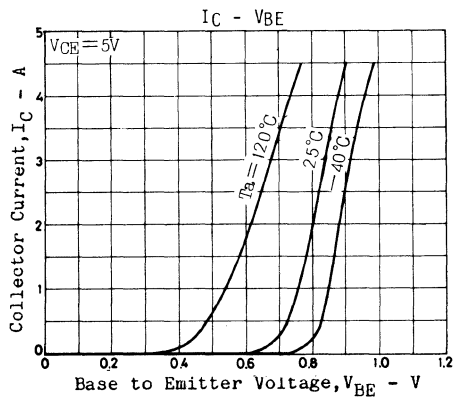
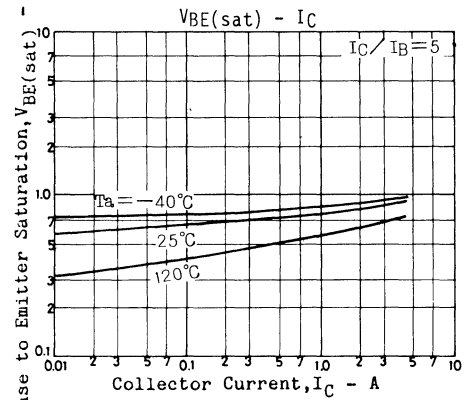
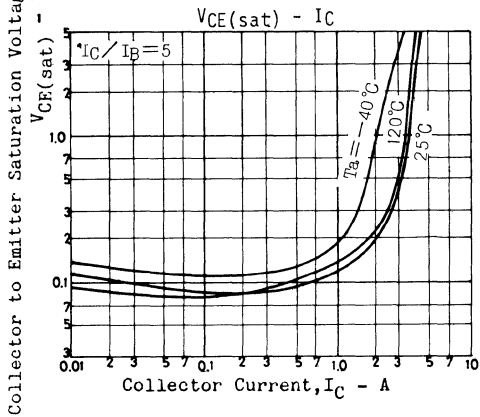
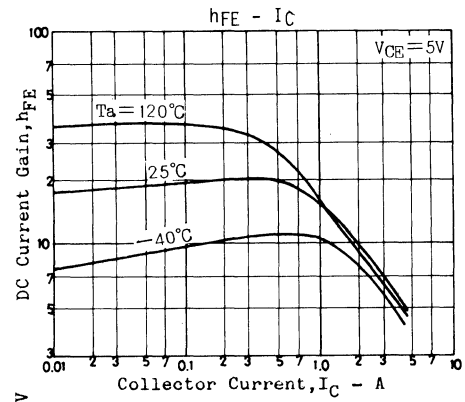
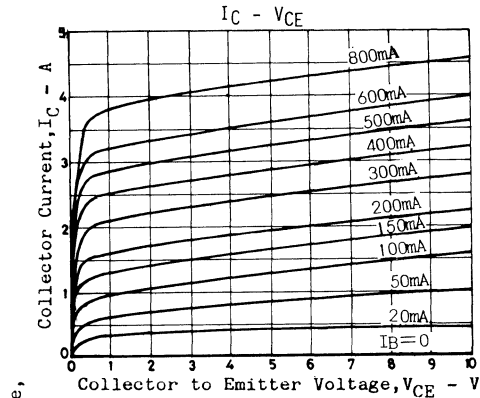
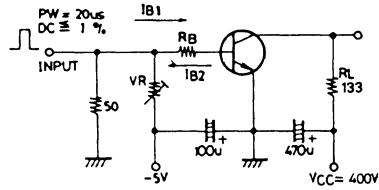
Case Outline 2022 (unit:mm)

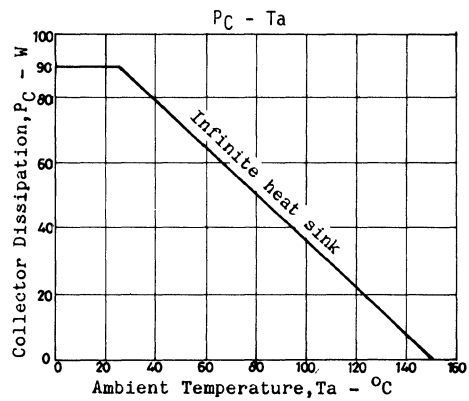
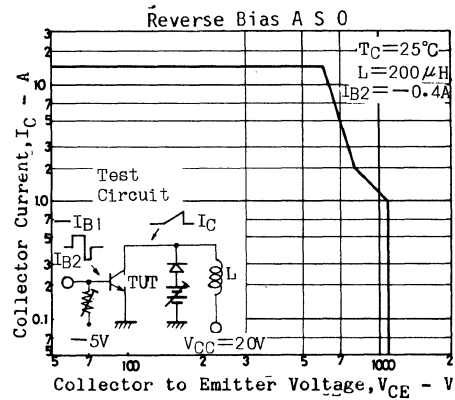
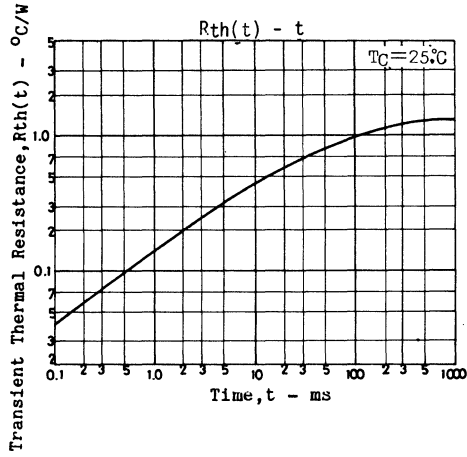
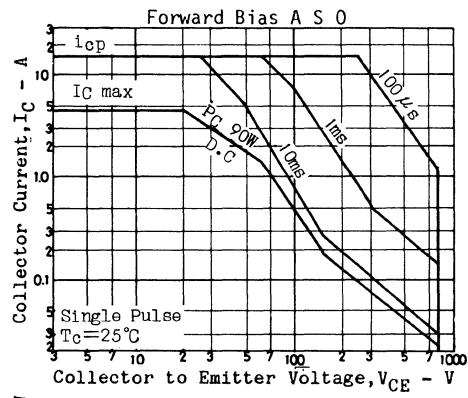


E: Emitter
C: Collector
B: Base

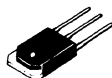
SANYO: T03PB

Switching Time Test Circuit





2SC3460



2022

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1594A

Features

- High breakdown voltage and high reliability.
- Fast switching speed (t_f : 0.1us typ.)
- Wide ASO.
- Adoption of MBIT process.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

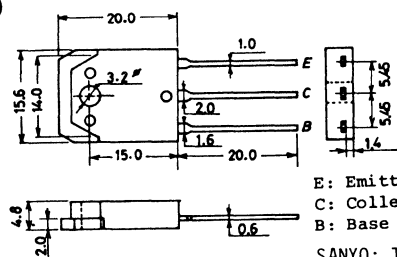
			unit
Collector to Base Voltage	V_{CB0}	1100	V
Collector to Emitter Voltage	V_{CE0}	800	V
Emitter to Base Voltage	V_{EB0}	7	V
Collector Current	I_C	6	A
Peak Collector Current	i_{cp}	$PW \leq 300\mu\text{s}, \text{Duty Cycle} \leq 10\%$	
		20	A
Base Current	I_B	3	A
Collector Dissipation	P_C	$T_C=25^\circ\text{C}$	
		100	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	
			$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=800\text{V}, I_E=0$			10	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=5\text{V}, I_C=0$			10	μA
DC Current Gain	$h_{FE(1)}$	$V_{CE}=5\text{V}, I_C=0.4\text{A}$	10			
	$h_{FE(2)}$	$V_{CE}=5\text{V}, I_C=2\text{A}$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=0.4\text{A}$		15		MHz
Output Capacitance	c_{ob}	$V_{CB}=10\text{V}, f=1\text{MHz}$		120		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=3\text{A}, I_B=0.6\text{A}$			2.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=3\text{A}, I_B=0.6\text{A}$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1\text{mA}, I_E=0$	1100			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=5\text{mA}, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1\text{mA}, I_C=0$	7			V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C=3\text{A}$	800			V
		$I_{B1}=-I_{B2}=0.6\text{A},$				
		$L=1\text{mH}, \text{Clamped}$				
Turn-On Time	t_{on}	$V_{CC}=400\text{V},$ $5I_{B2}=-2.5I_{B2}=I_C=4\text{A},$ $R_L=100\text{ohm}$			0.5	us
Storage Time	t_{stg}				3.0	us
Fall Time	t_f				0.3	us

Case Outline 2022

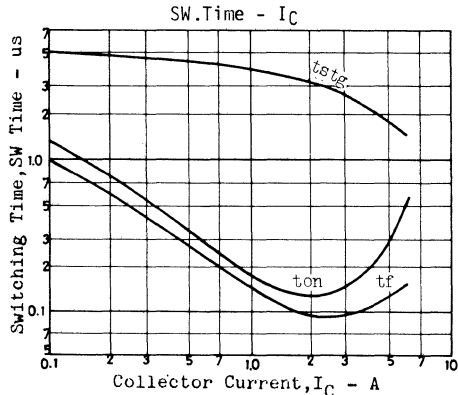
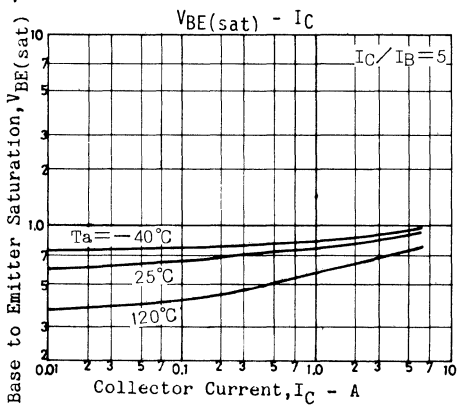
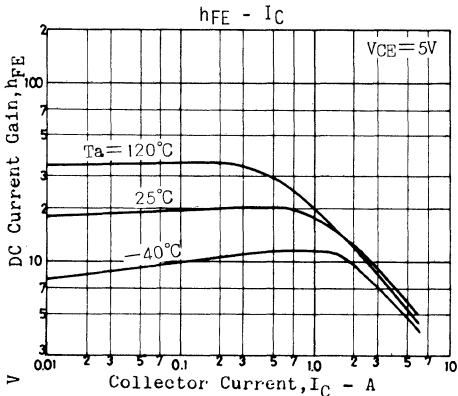
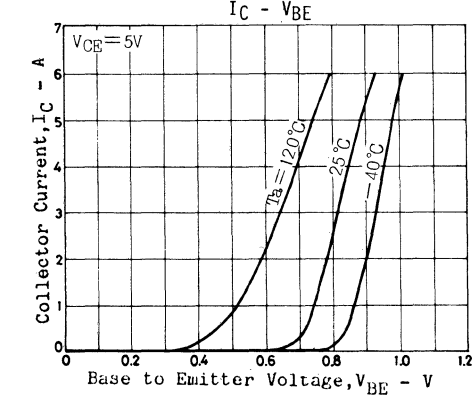
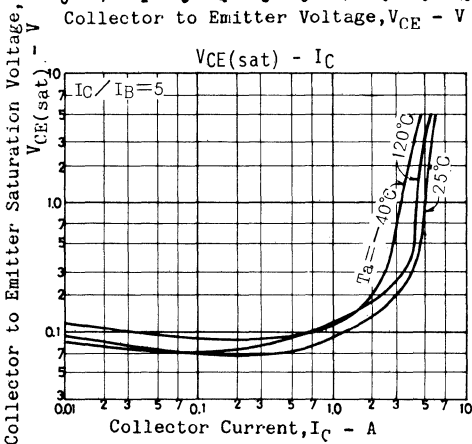
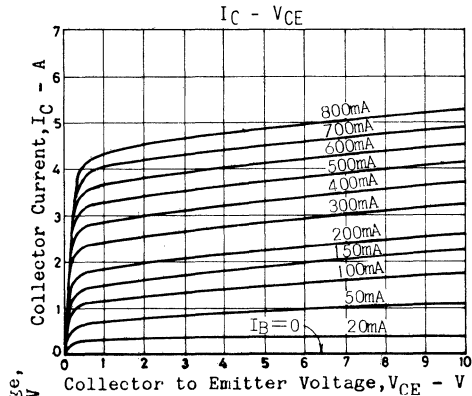
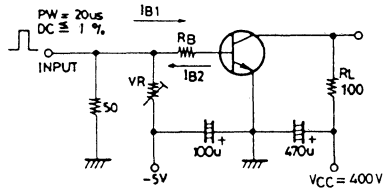
(unit:mm)

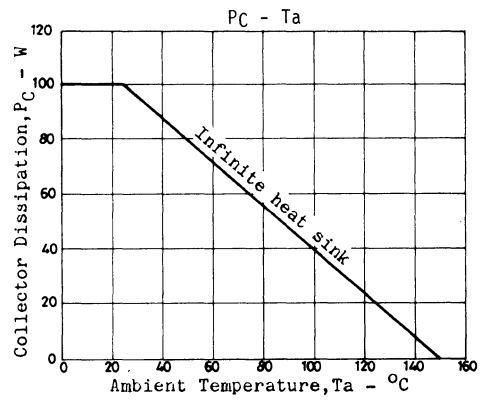
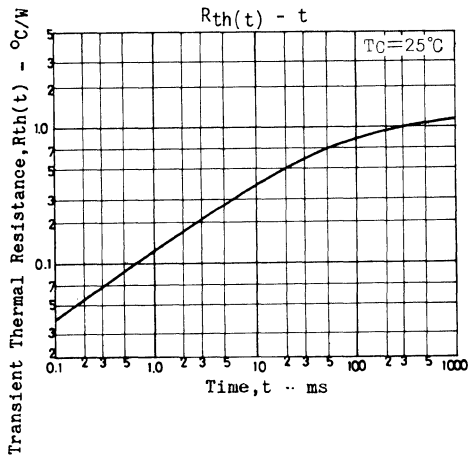
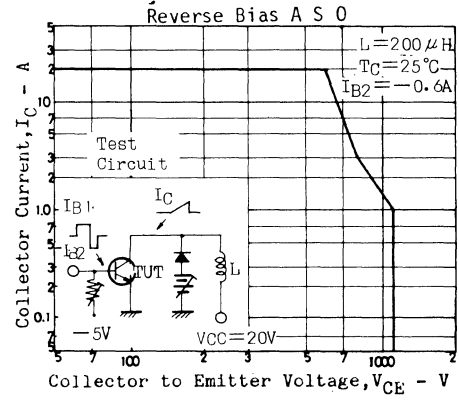
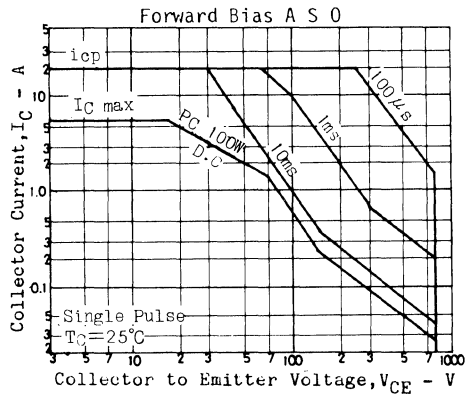


E: Emitter
C: Collector
B: Base

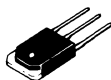
SANYO: T03PB

Switching Time Test Circuit





2SC3461



2022

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1596A

Features

- High breakdown voltage and high reliability.
- Fast switching speed (t_f : 0.1us typ.)
- Wide ASO.
- Adoption of MBIT process.

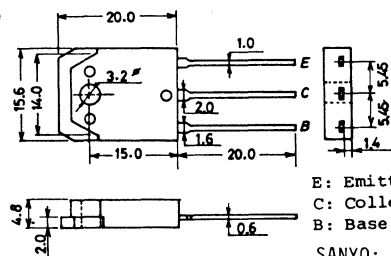
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

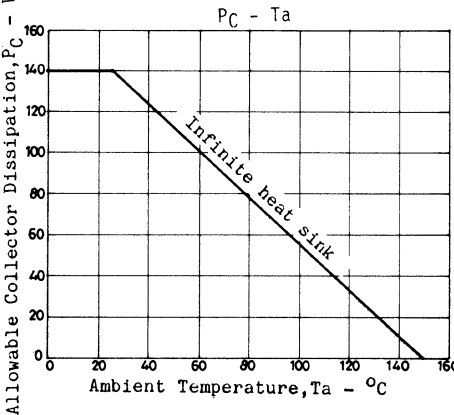
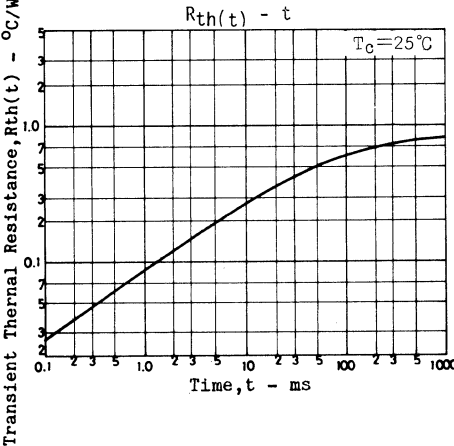
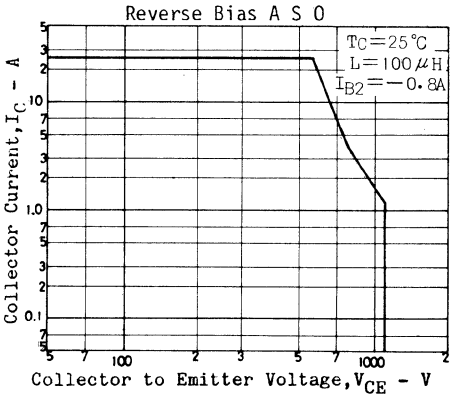
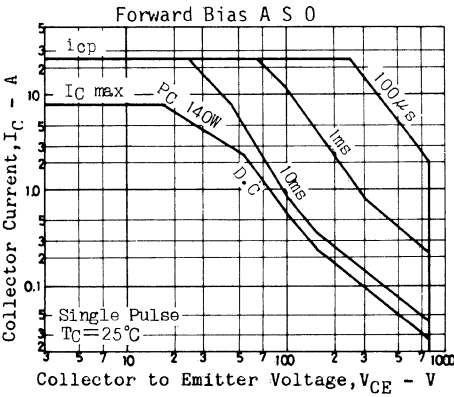
			unit
Collector to Base Voltage	V_{CB0}	1100	V
Collector to Emitter Voltage	V_{CE0}	800	V
Emitter to Base Voltage	V_{EB0}	7	V
Collector Current	I_C	8	A
Peak Collector Current	i_{cp}	$PW \leq 300\mu s, \text{Duty Cycle} \leq 10\%$	25 A
Base Current	I_B	4	A
Collector Dissipation	P_C	$T_C=25^\circ\text{C}$	140 W
Junction Temperature	T_j		150 $^\circ\text{C}$
Storage Temperature	T_{stg}		-55 to +150 $^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800V, I_E=0$			10	uA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			10	uA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5V, I_C=0.6A$	10			
	$h_{FE}(2)$	$V_{CE}=5V, I_C=3A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.6A$		15		MHz
Output Capacitance	c_{ob}	$V_{CB}=10V, f=1\text{MHz}$		155		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=4A, I_B=0.8A$			2.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=4A, I_B=0.8A$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1mA, I_E=0$	1100			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=5mA, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1mA, I_C=0$		7		V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C=4A$	800			V
Turn-On Time	t_{on}	$I_{B1}=-I_{B2}=0.8A, L=500\mu H, \text{Clamped}$			0.5	us
Storage Time	t_{stg}	$V_{CC}=400V, 5I_{B2}=-2.5I_{B2}=I_C=6A,$			3.0	us
Fall Time	t_f	$R_L=66.7\text{ohm}$			0.3	us

Case Outline 2022 (unit:mm)





2SC3467



2006A

NPN/PNP Epitaxial Planar
Silicon Transistors**2SA1370**

High-Definition CRT Display Video Output Applications

E1412A

Use

- Color TV chroma output and high breakdown voltage driver

Features

- High breakdown voltage: $V_{CEO} \geq 200V$
- Small reverse transfer capacitance and excellent high frequency characteristic
 $c_{re} = 1.2pF$ (NPN), $1.7pF$ (PNP)
- Adoption of FBET process

(): 2SA1370

Absolute Maximum Ratings at $T_a = 25^\circ C$

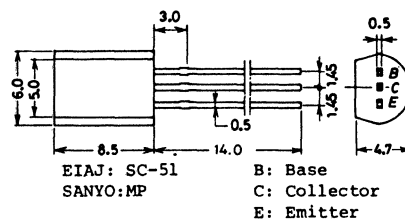
			unit
Collector to Base Voltage	V_{CBO}	(-) 200	V
Collector to Emitter Voltage	V_{CEO}	(-) 200	V
Emitter to Base Voltage	V_{EBO}	(-) 5	V
Collector Current	I_C	(-) 100	mA
Peak Collector Current	i_{cp}	(-) 200	mA
Collector Dissipation	P_C	1.0	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

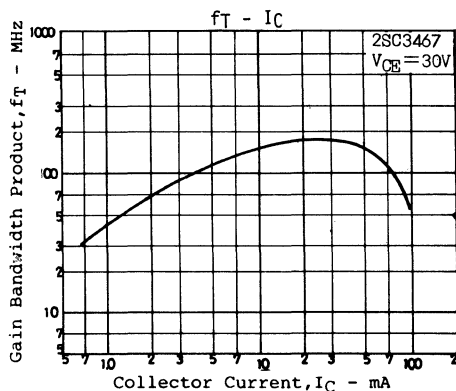
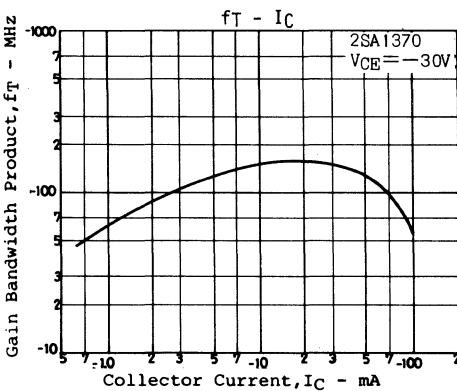
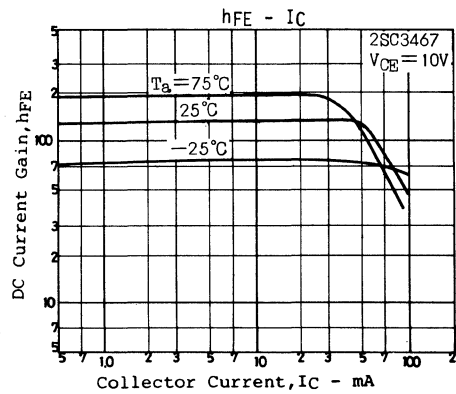
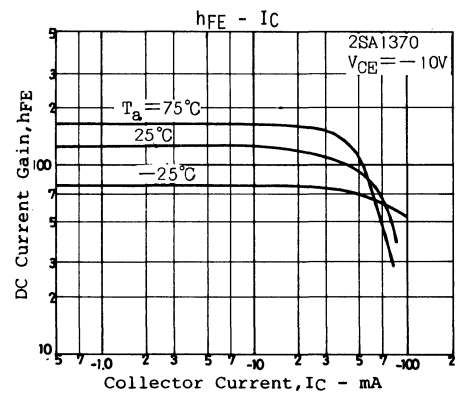
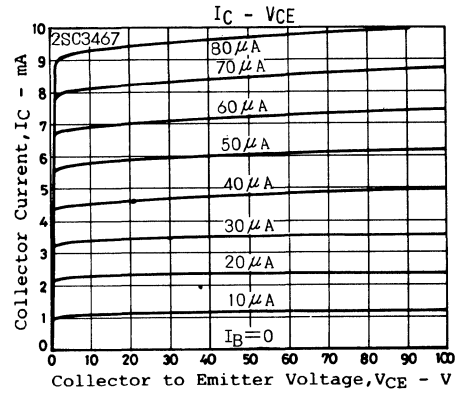
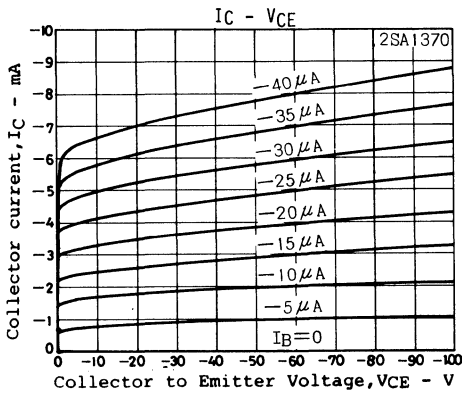
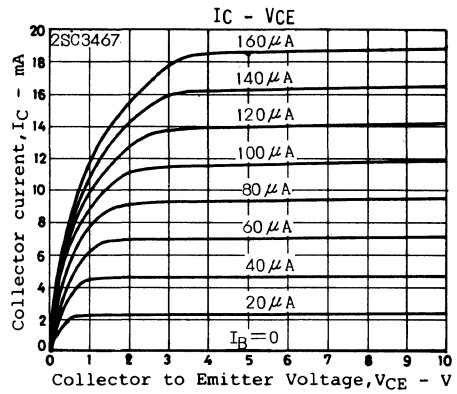
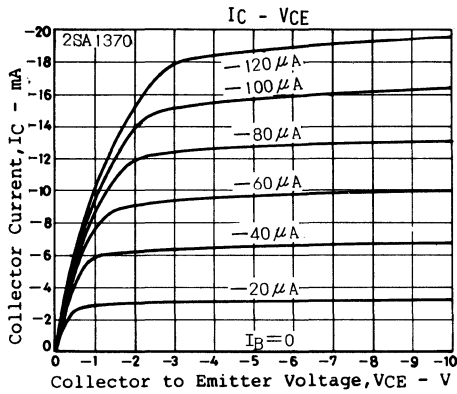
Electrical Characteristics at $T_a = 25^\circ C$

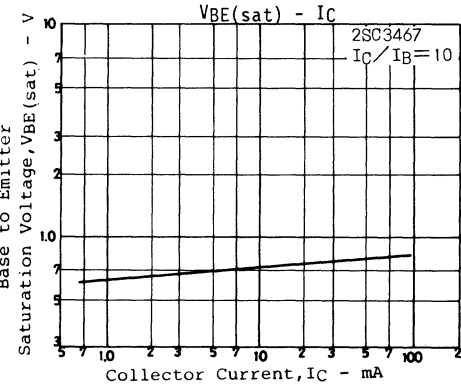
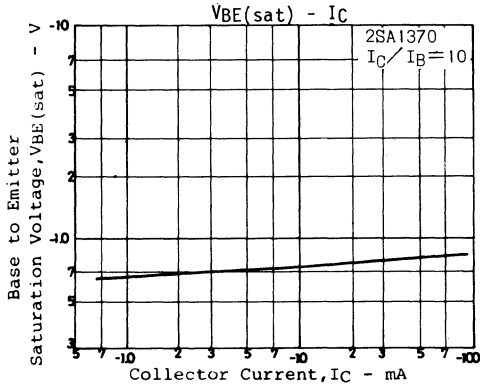
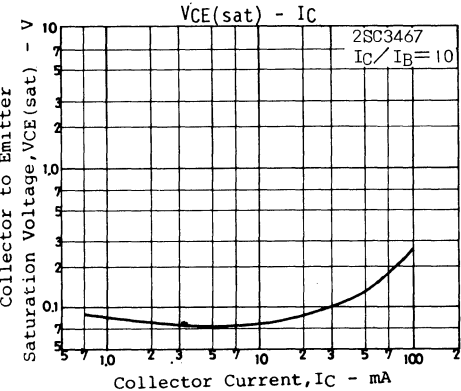
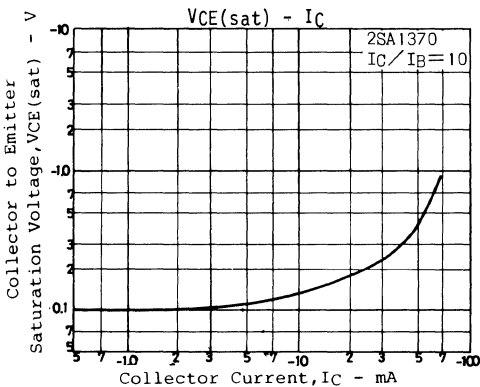
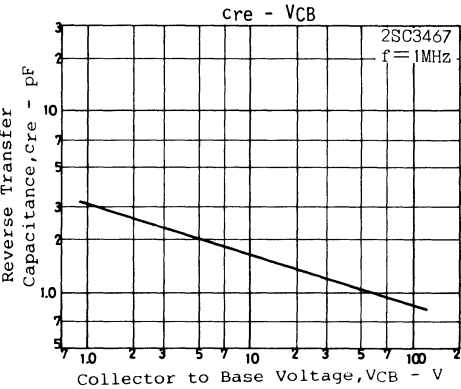
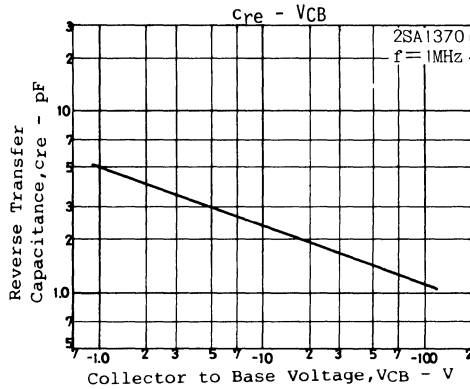
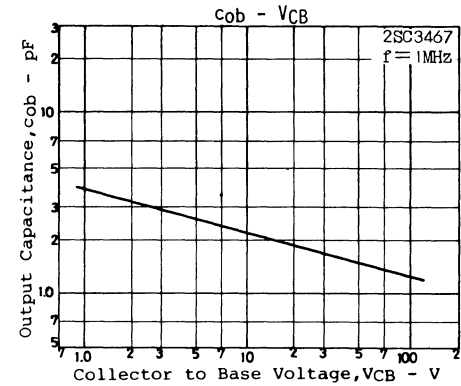
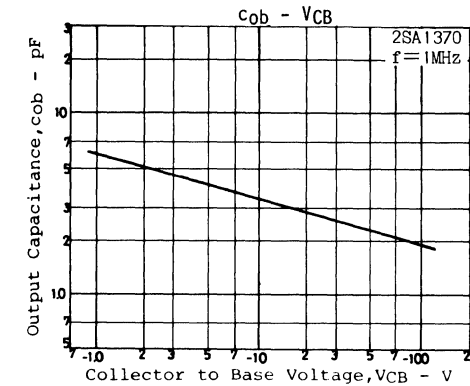
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-) 150V, I_E = 0$			(-) 0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-) 4V, I_C = 0$			(-) 0.1	μA
DC Current Gain	h_{FE}	$V_{CE} = (-) 10V, I_C = (-) 10mA$	40*		320*	
Gain Bandwidth Product	f_T	$V_{CE} = (-) 30V, I_C = (-) 10mA$		150		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-) 20mA, I_B = (-) 2mA$			(-) 0.6	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = (-) 20mA, I_B = (-) 2mA$			(-) 1.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-) 10\mu A, I_E = 0$	(-) 200			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-) 1mA, R_{BE} = \infty$	(-) 200			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-) 10\mu A, I_C = \infty$	(-) 5			V
Output Capacitance	c_{ob}	$V_{CB} = (-) 30V, f = 1MHz$		1.7 (2.6)		pF
Reverse Transfer Capacitance	c_{re}	$V_{CB} = (-) 30V, f = 1MHz$		1.2 (1.7)		pF

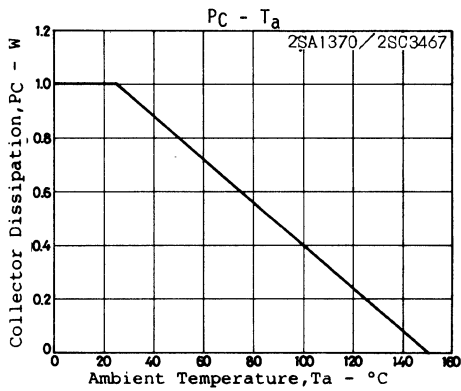
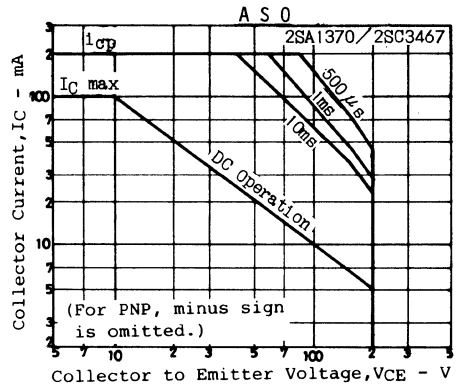
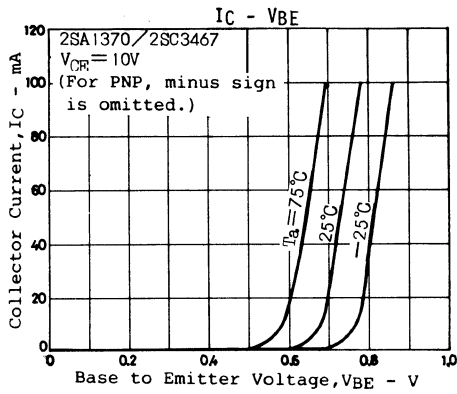
* : The 2SA1370/2SC3467 are classified by 10mA h_{FE} as follows:

40	C	80	60	D	120	100	E	200	160	F	320
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Case Outline 2006A
(unit:mm)







2SC3468



2006A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1371

High-Definition CRT Display Video Output Applications

Ⓔ1413B

Use

- Color TV chroma output and high breakdown voltage driver

Features

- High breakdown voltage: $V_{CE0} \geq 300V$
- Small reverse transfer capacitance and excellent high frequency characteristic $c_{re} = 1.8pF$ (NPN), $2.3pF$ (PNP)
- Adoption of MBIT process

(): 2SA1371

Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	(-) 300	V
Collector to Emitter Voltage	V_{CEO}	(-) 300	V
Emitter to Base Voltage	V_{EBO}	(-) 5	V
Collector Current	I_C	(-) 100	mA
Peak Collector Current	i_{cp}	(-) 200	mA
Collector Dissipation	P_C	1.0	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

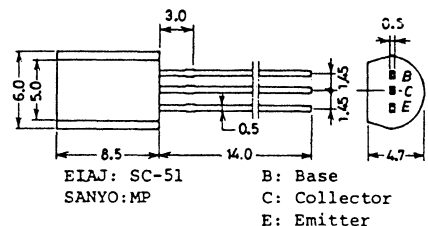
Electrical Characteristics at $T_a = 25^\circ C$

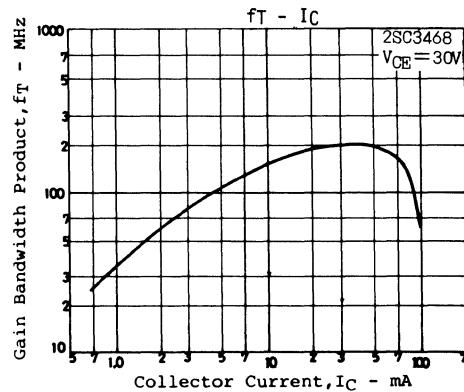
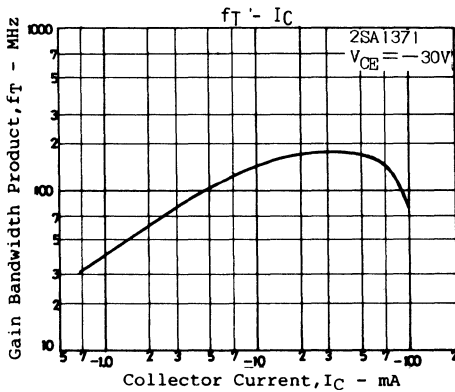
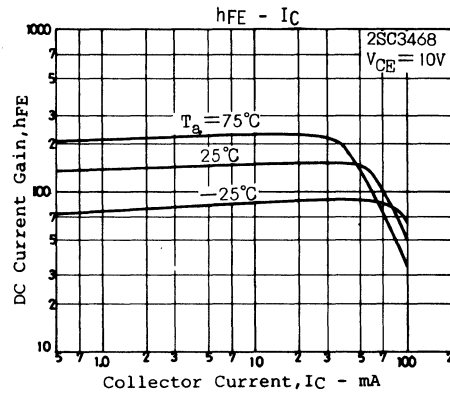
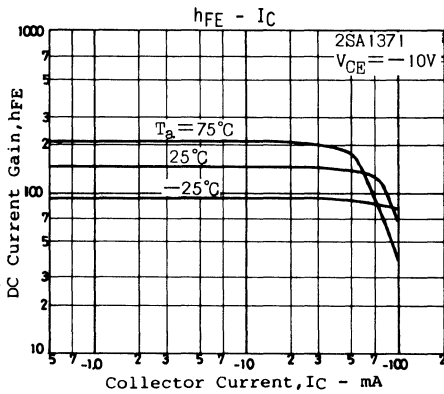
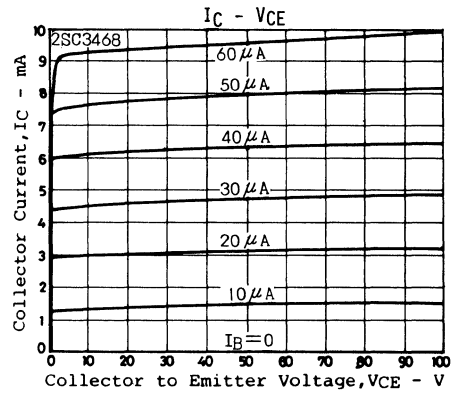
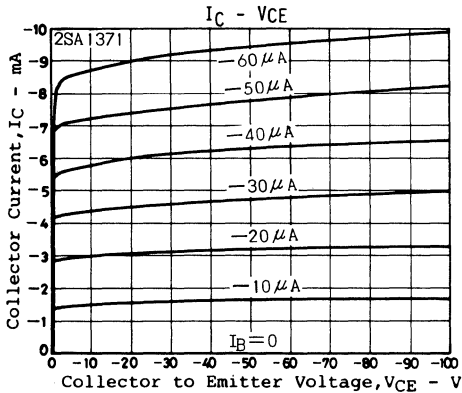
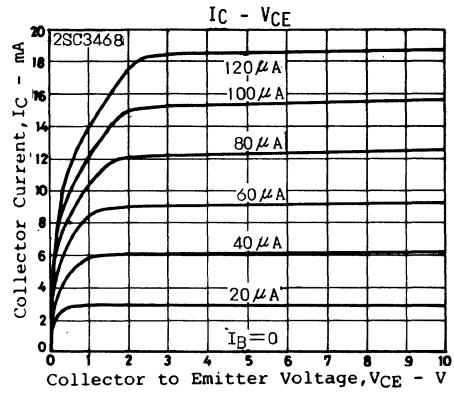
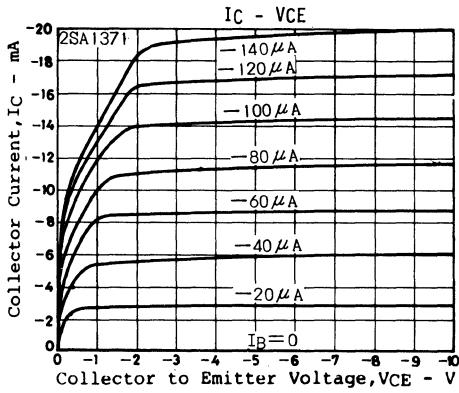
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-) 200V, I_E = 0$			(-) 0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-) 4V, I_C = 0$			(-) 0.1	μA
DC Current Gain	h_{FE}	$V_{CE} = (-) 10V, I_C = (-) 10mA$	40*		320*	
Gain Bandwidth Product	f_T	$V_{CE} = (-) 30V, I_C = (-) 10mA$		150		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-) 20mA, I_B = (-) 2mA$			(-) 0.6	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = (-) 20mA, I_B = (-) 2mA$			(-) 1.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-) 10\mu A, I_E = 0$	(-) 300			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-) 1mA, R_{BE} = \infty$	(-) 300			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-) 10\mu A, I_C = 0$	(-) 5			V
Output Capacitance	c_{ob}	$V_{CB} = (-) 30V, f = 1MHz$		2.6 (3.1)		pF
Reverse Transfer Capacitance	c_{re}	$V_{CB} = (-) 30V, f = 1MHz$		1.8 (2.3)		pF

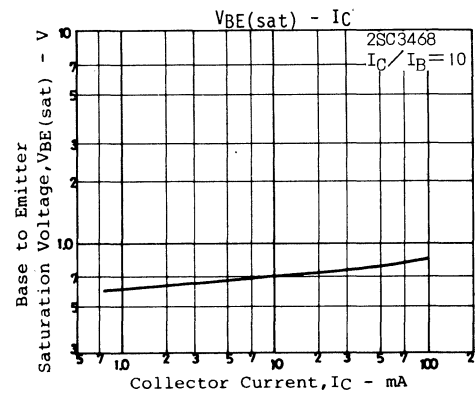
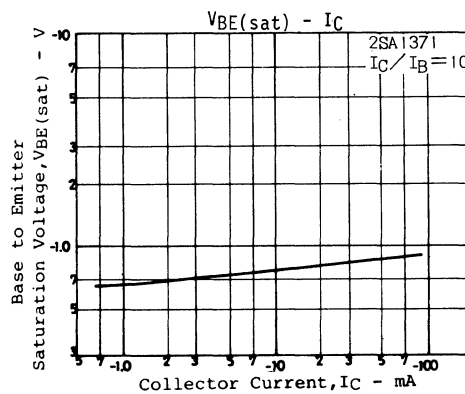
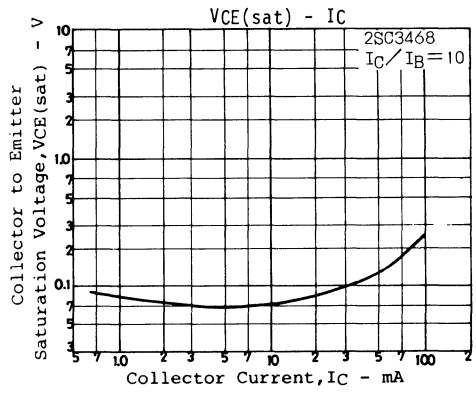
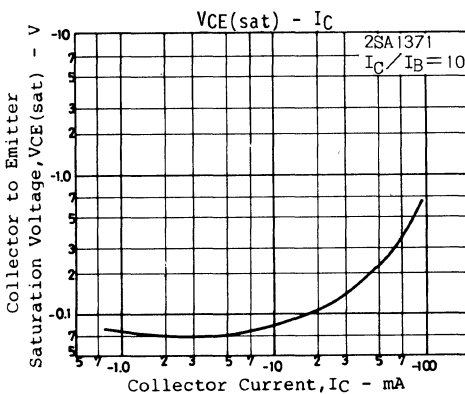
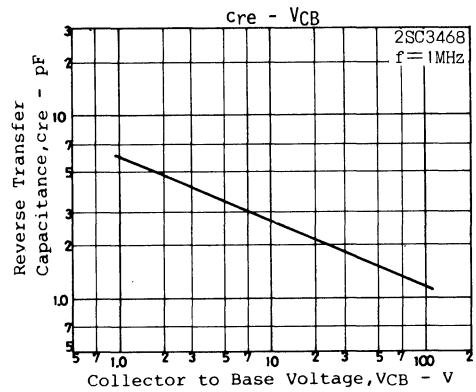
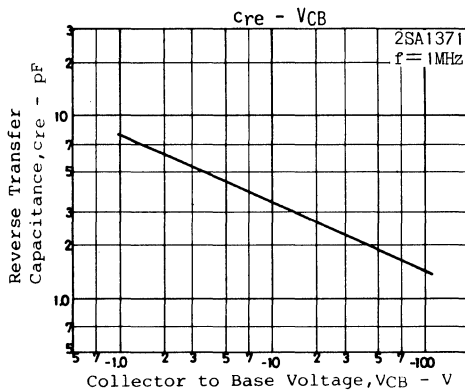
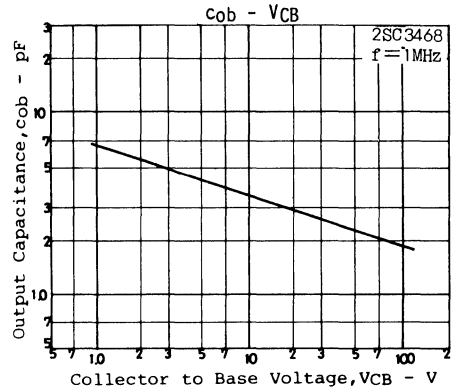
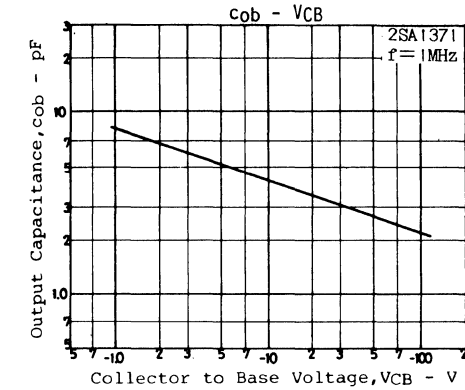
* : The 2SA1371/2SC3468 are classified by 10mA h_{FE} as follows:

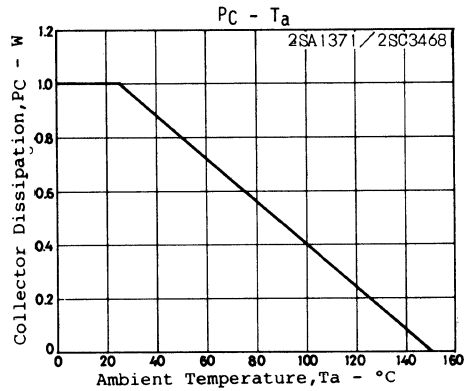
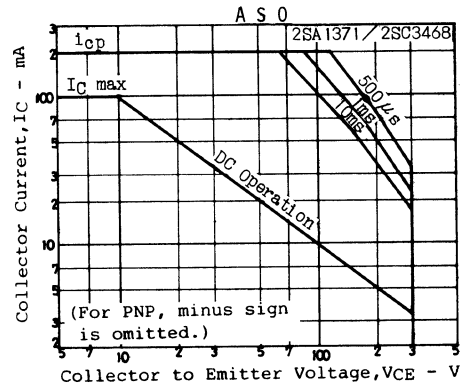
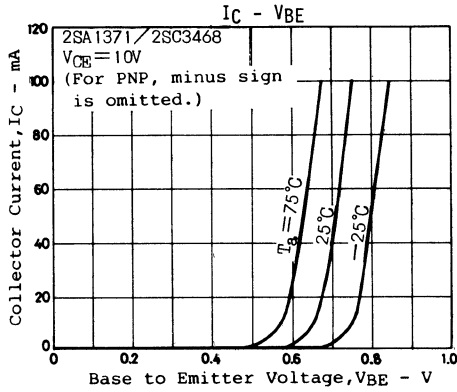
40	C	80	60	D	120	100	E	200	160	F	320
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Case Outline 2006A
(unit:mm)









2SC3479



2022

NPN Triple Diffused Planar
Silicon Transistor

High-Definition CRT Display Horizontal Deflection Output Applications (with Dampener Diode)

©1394

Features:

- High breakdown voltage and high reliability
- High switching speed: $t_f=0.3\mu s$ max.
- Capable of being mounted easily due to one-point fixing type plastic mold package

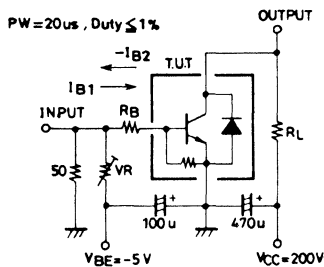
Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_C	2.5	A
Peak Collector Current	i_{cp}	10	A
Collector Dissipation	P_C	$T_C=25^\circ C$ 80	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

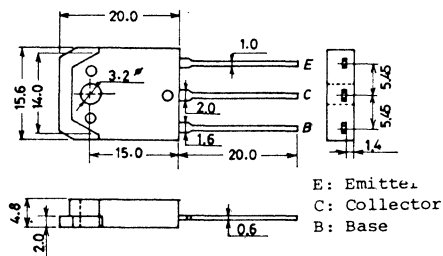
Electrical Characteristics at $T_a=25^\circ C$

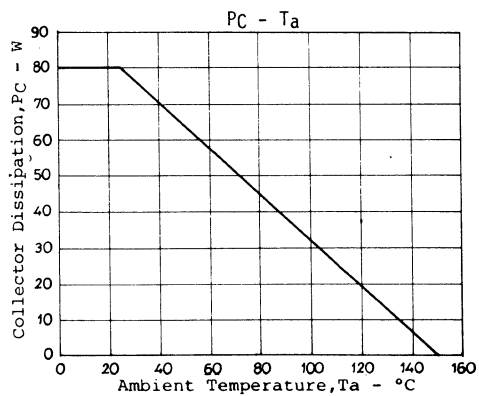
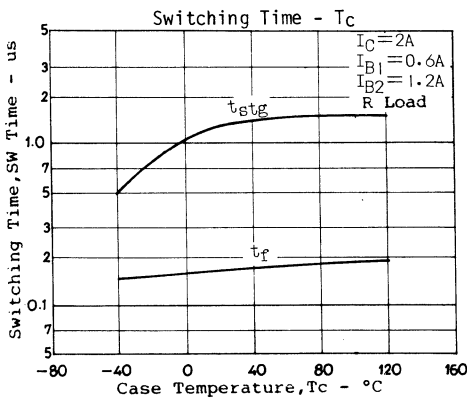
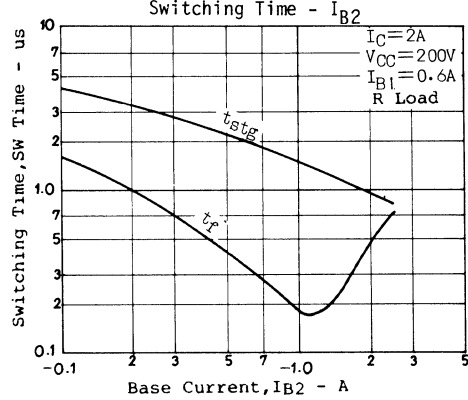
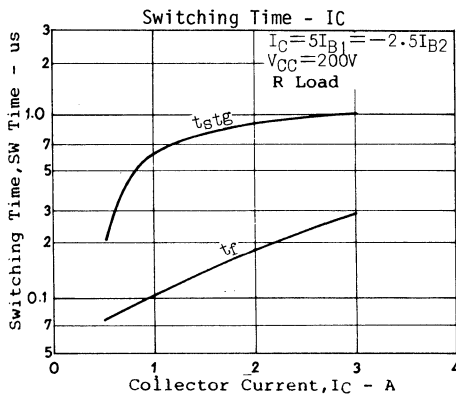
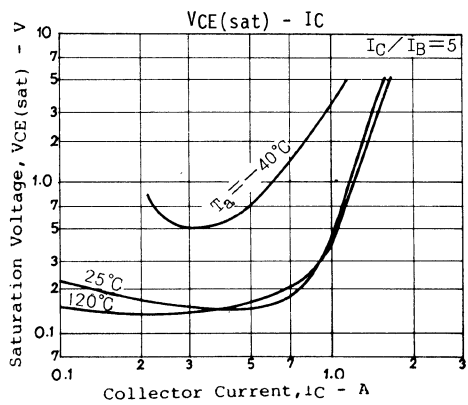
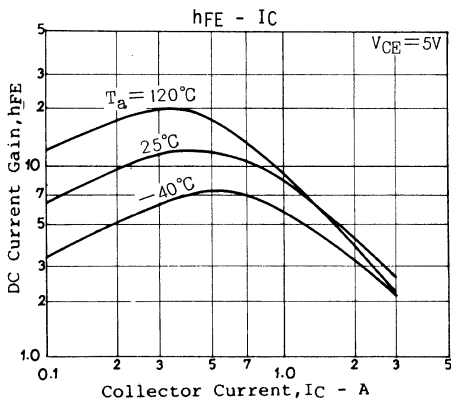
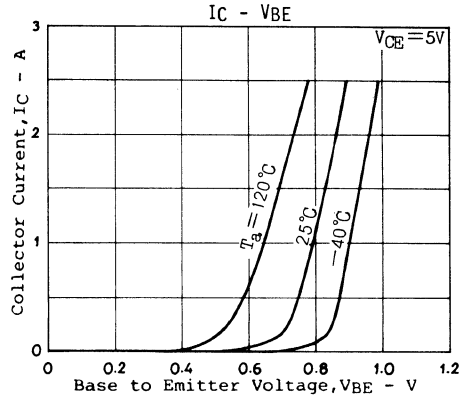
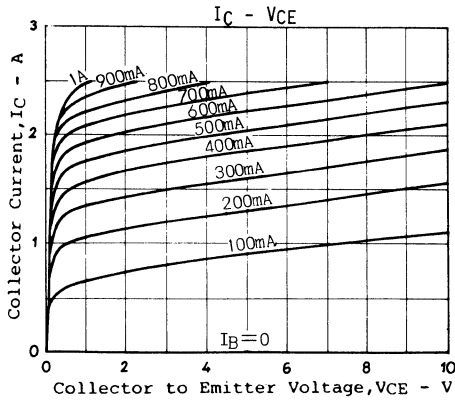
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4V, I_C=0$	40		130	mA
DC Current Gain	h_{FE}	$V_{CE}=5V, I_C=0.5A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.5A$		3		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=2A, I_B=0.6A$			8	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=2A, I_B=0.6A$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5mA, I_E=0$	1500			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=5mA, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=200mA, I_C=0$	7			V
Diode Forward Voltage	V_F	$I_{EC}=2.5A$			2	V
Storage Time	t_{stg}	$I_C=2A, I_{B1}=0.6A,$			3.0	μs
Fall Time	t_f	$I_{B2}=-1.2A, V_{CC}=200V,$			0.3	μs
		$R_L=100\Omega$				

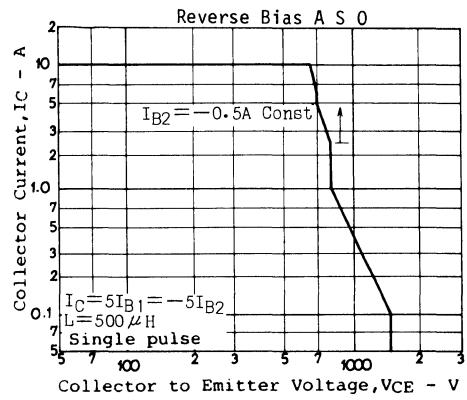
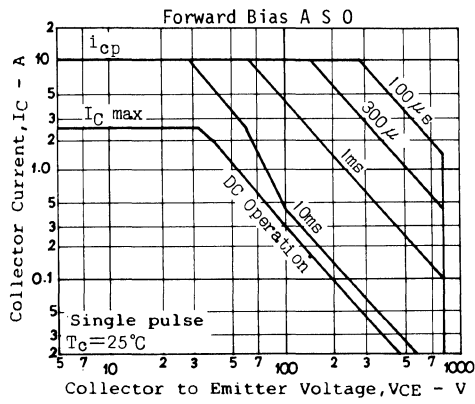
Switching Time Test Circuit



Case Outline 2022 (unit:mm)







2SC3480



2022

NPN Triple Diffused Planar
Silicon Transistor

High-Definition CRT Display Horizontal Deflection Output Applications (with Damper Diode)

©1395

Features:

- High breakdown voltage and high reliability
- High switching speed: $t_f=0.3\mu s$ max.
- Capable of being mounted easily due to one-point fixing type plastic mold package

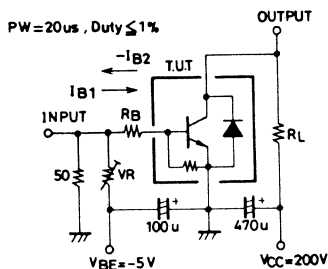
Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	VCBO	1500	V
Collector to Emitter Voltage	VCEO	800	V
Emitter to Base Voltage	VEBO	7	V
Collector Current	IC	3.5	A
Peak Collector Current	icp	10	A
Collector Dissipation	PC	80	W
Junction Temperature	Tj	150	°C
Storage Temperature	Tstg	-55 to +150	°C

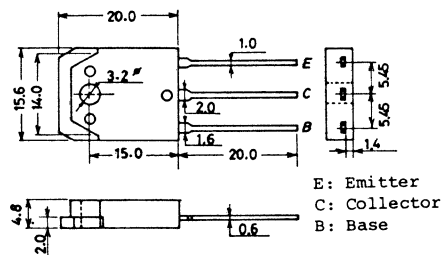
Electrical Characteristics at $T_a=25^\circ C$

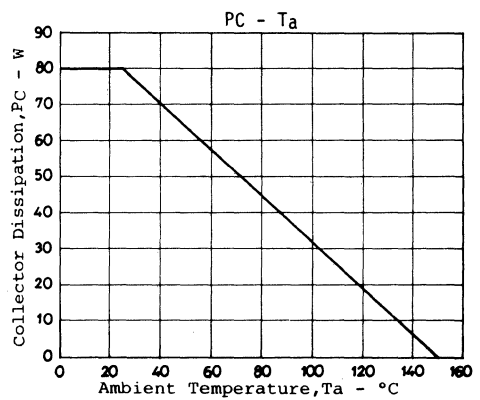
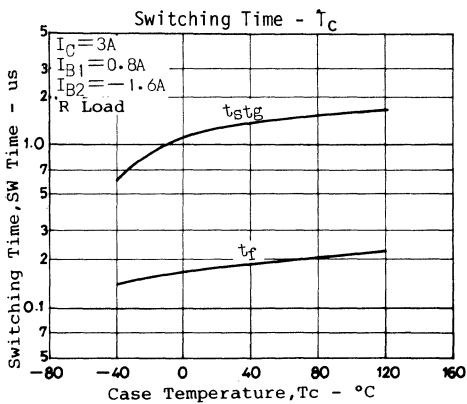
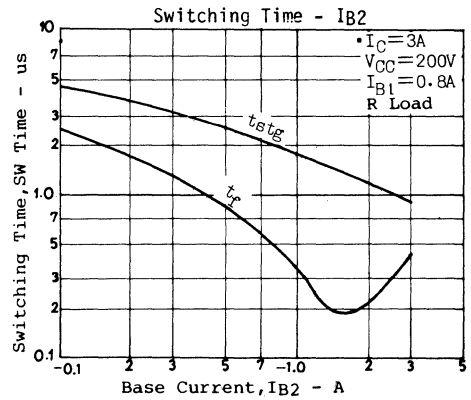
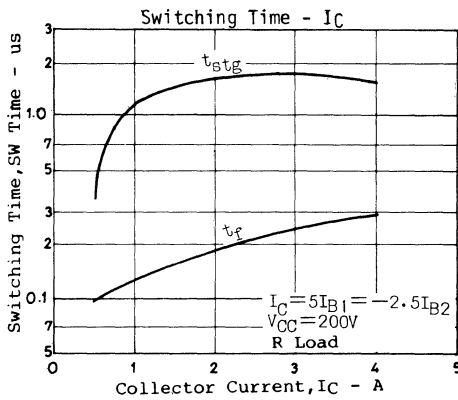
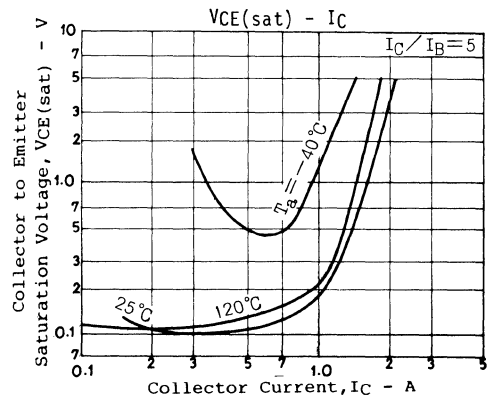
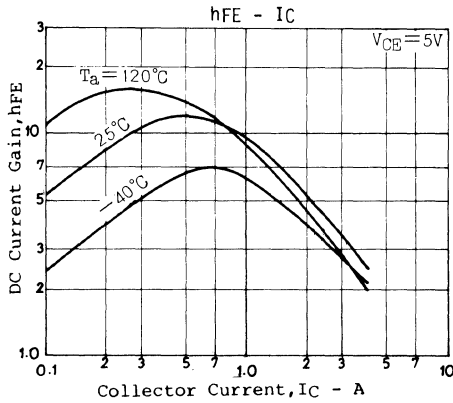
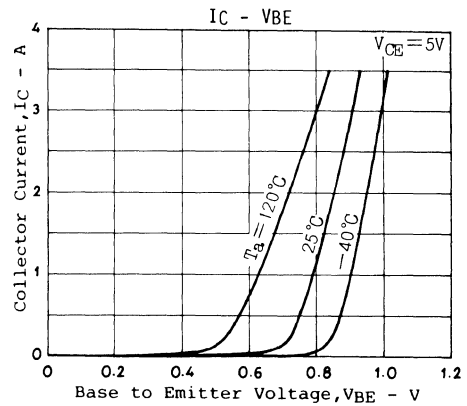
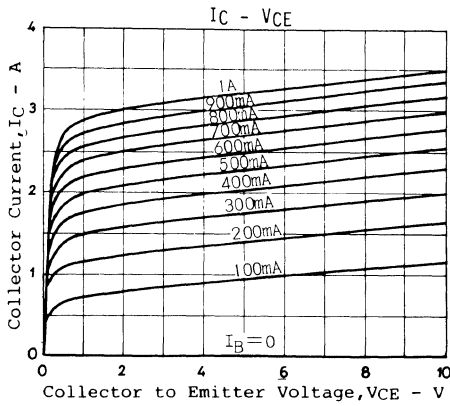
			min	typ	max	unit
Collector Cutoff Current	ICBO	VCB=800V, IE=0			10	uA
Emitter Cutoff Current	IEBO	VEB=4V, IC=0	40		130	mA
DC Current Gain	hFE	VCE=5V, IC=0.5A	8			
Gain Bandwidth Product	fT	VCE=10V, IC=0.5A		3		MHz
C-E Saturation Voltage	VCE(sat)	IC=2.5A, IB=0.8A			8	V
B-E Saturation Voltage	VBE(sat)	IC=2.5A, IB=0.8A			1.5	V
C-B Breakdown Voltage	V(BR)CBO	IC=5mA, IE=0	1500			V
C-E Breakdown Voltage	V(BR)CEO	IC=5mA, RBE=∞	800			V
E-B Breakdown Voltage	V(BR)EBO	IE=200mA, IC=0	7			V
Diode Forward Voltage	VF	IEC=3.5A			2	V
Storage Time	tstg	IC=3A, IB1=0.8A,			3.0	us
Fall Time	tf	IB2=-1.6A, VCC=200V, RL=66.7ohm			0.3	us

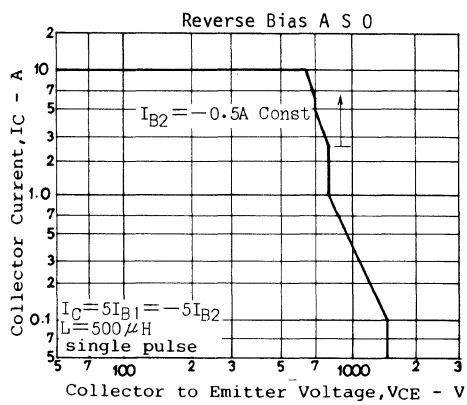
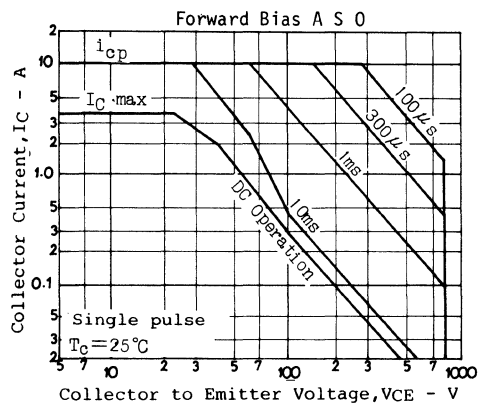
Switching Time Test Circuit

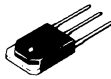


Case Outline 2022 (unit:mm)









2022

NPN Triple Diffused Planar Silicon Transistor

High-Definition CRT Display Horizontal Deflection Output Applications (with Damper Diode)

Ⓔ1396

Features:

- High breakdown voltage and high reliability
- High switching speed: $t_f=0.3\mu s$ max.
- Capable of being mounted easily due to one-point fixing type plastic mold package

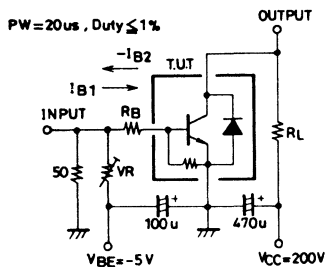
Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

Absolute Maximum Ratings at Ta=25°C			unit
Collector to Base Voltage	VCBO	1500	V
Collector to Emitter Voltage	VCEO	800	V
Emitter to Base Voltage	VEBO	7	V
Collector Current	IC	5	A
Peak Collector Current	icp	16	A
Collector Dissipation	PC	120	W
Junction Temperature	Tj	150	°C
Storage Temperature	Tstg	-55 to +150	°C

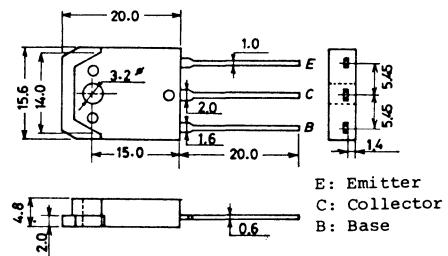
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

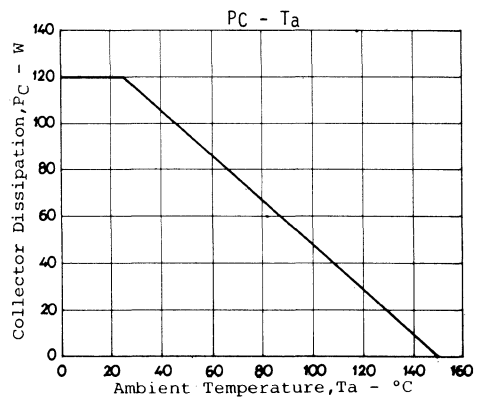
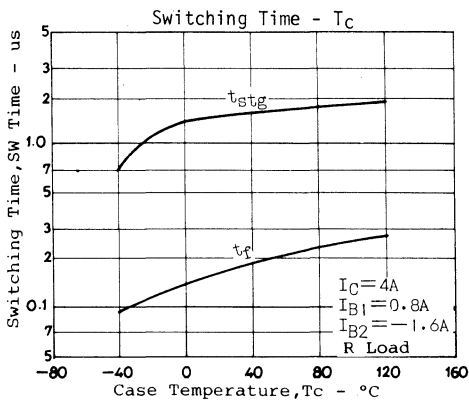
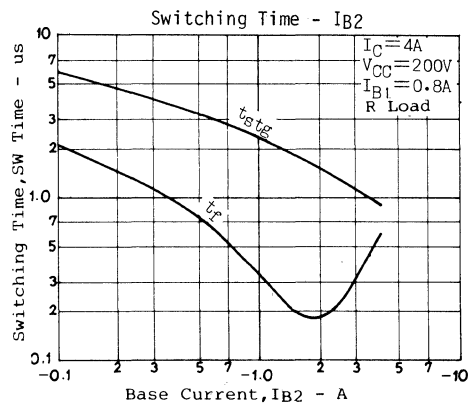
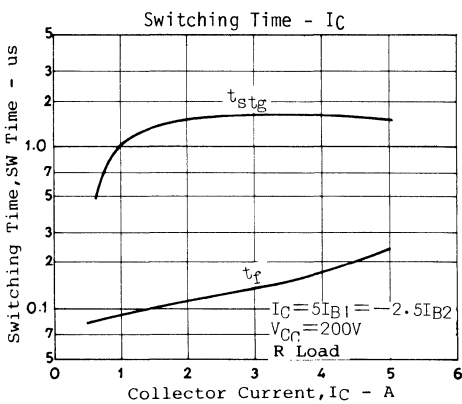
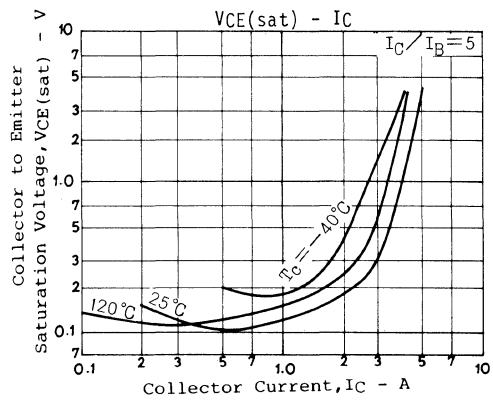
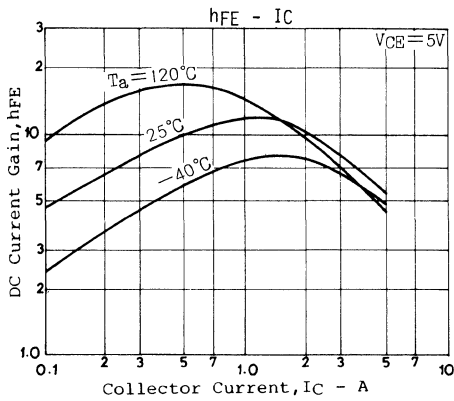
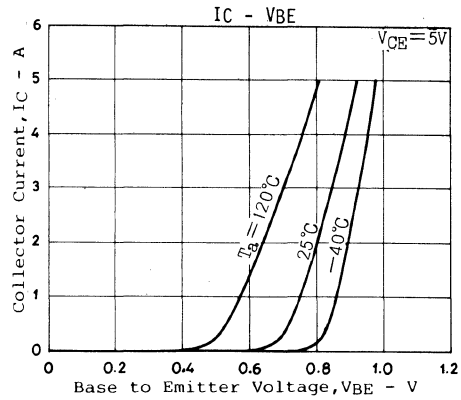
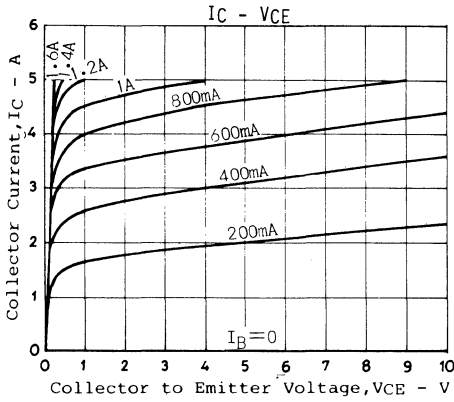
Electrical Characteristics at Ta=25°C			min	typ	max	unit
Collector Cutoff Current	ICBO	VCB=800V, IE=0			10	uA
Emitter Cutoff Current	IEBO	VEB=4V, IC=0	40		130	mA
DC Current Gain	hFE	VCE=5V, IC=1A	8			
Gain Bandwidth Product	fT	VCE=10V, IC=1A		3		MHz
C-E Saturation Voltage	VCE(sat)	IC=4A, IB=1A			5	V
B-E Saturation Voltage	VBE(sat)	IC=4A, IB=1A			1.5	V
C-B Breakdown Voltage	V(BR)CBO	IC=5mA, IE=0	1500			V
C-E Breakdown Voltage	V(BR)CEO	IC=5mA, RBE= ∞	800			V
E-B Breakdown Voltage	V(BR)EBO	IE=200mA, IC=0	7			V
Diode Forward Voltage	VF	IEC=5A			2	V
Storage Time	tstg	IC=4A, IB1=0.8A,			3.0	us
Fall Time	tf	IB2=-1.6A, VCC=200V, RL=50ohm			0.3	us

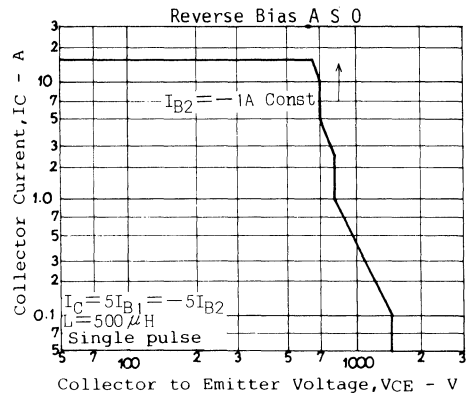
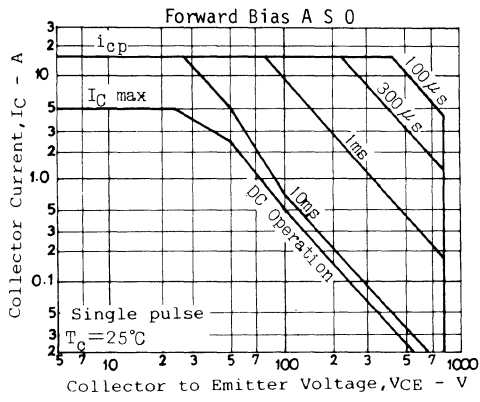
Switching Time Test Circuit



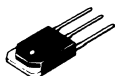
Case Outline 2022
(unit:mm)







2SC3482



2022

NPN Triple Diffused Planar
Silicon Transistor

High-Definition CRT Display Horizontal Deflection Output Applications (with Damper Diode)

©1397

Features:

- High breakdown voltage and high reliability
- High switching speed: $t_f=0.3\mu s$ max.
- Capable of being mounted easily due to one-point fixing type plastic mold package

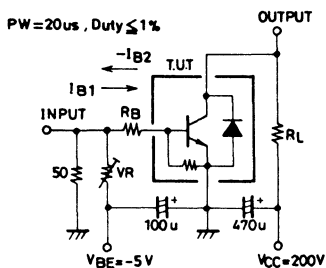
Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_C	6	A
Peak Collector Current	i_{cp}	16	A
Collector Dissipation	P_C	$T_c=25^\circ C$ 120	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

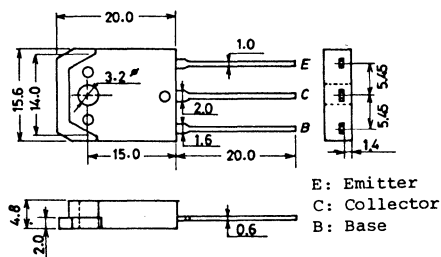
Electrical Characteristics at $T_a=25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$I_{CB}=800V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4V, I_C=0$	40		130	mA
DC Current Gain	h_{FE}	$V_{CE}=5V, I_C=1A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=1A$		3		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=5A, I_B=1.2A$			5	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=5A, I_B=1.2A$			1.5	V
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C=5mA, I_E=0$	1500			V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_C=5mA, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E=200mA, I_C=0$	7			V
Diode Forward Voltage	V_F	$I_{EC}=6A$			2	V
Storage Time	t_{stg}	$I_C=5A, I_{B1}=1A,$			3.0	μs
Fall Time	t_f	$I_{B2}=-2A, V_{CC}=200V,$ $R_L=40\Omega$			0.3	μs

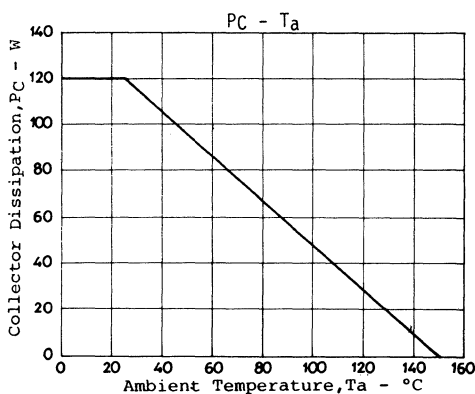
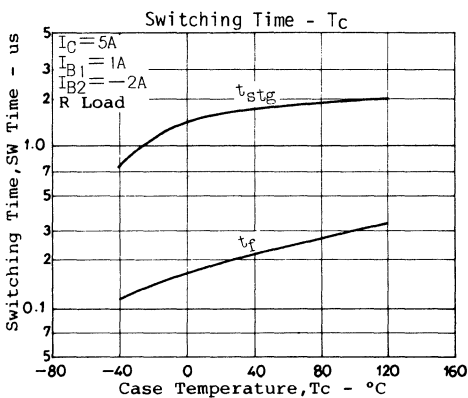
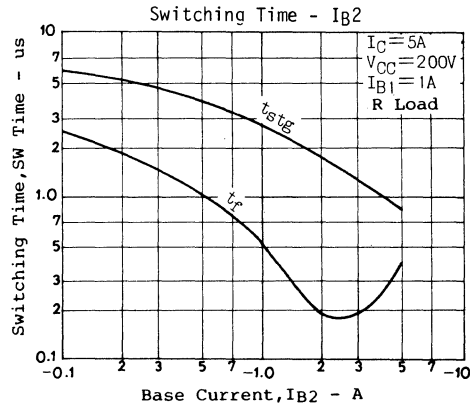
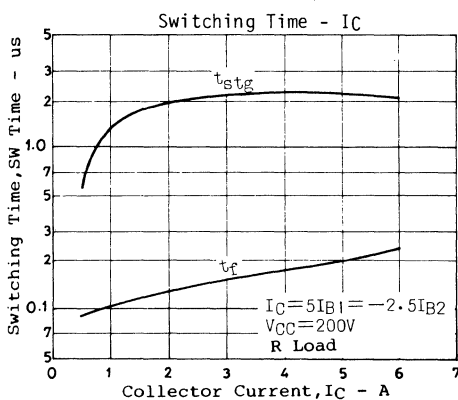
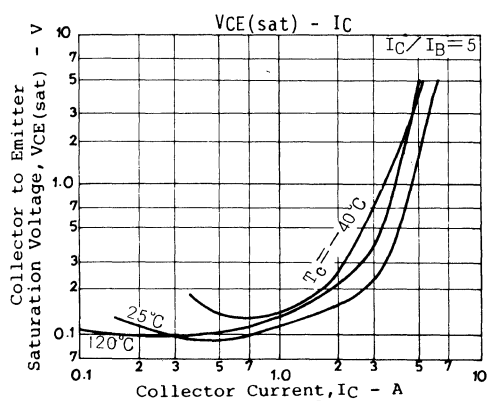
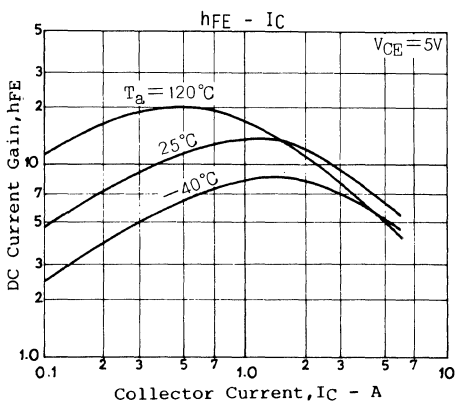
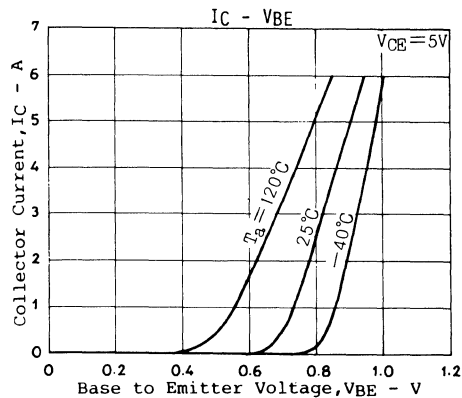
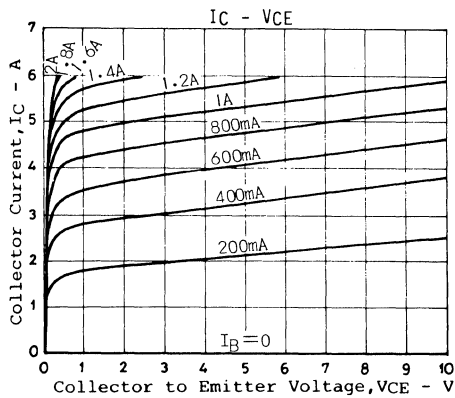
Switching Time Test Circuit

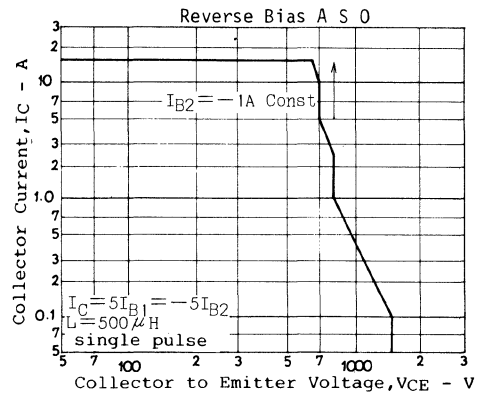
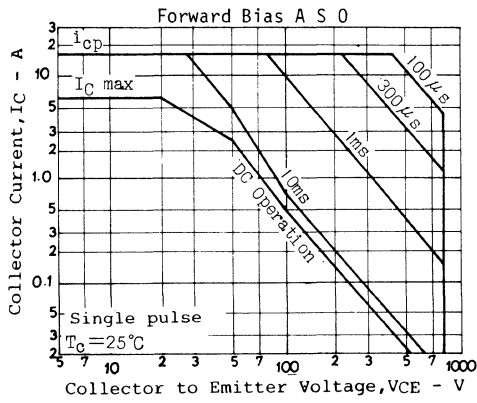


Case Outline 2022 (unit:mm)

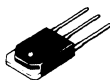


9303KI, MT No.1397-1/3





2SC3483



2022

NPN Triple Diffused Planar
Silicon Transistor

High-Definition CRT Display Horizontal Deflection Output Applications

©1398

Features:

- High breakdown voltage and high reliability
- High switching speed: $t_f=0.3\mu s$ max.
- Capable of being mounted easily due to one-point fixing type plastic mold package

Absolute Maximum Ratings at $T_a=25^\circ C$

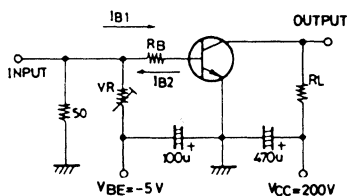
			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_C	2.5	A
Peak Collector Current	i_{cp}	10	A
Collector Dissipation	P_C	$T_c=25^\circ C$ 80	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a=25^\circ C$

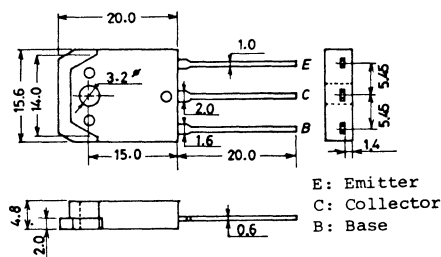
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			1	mA
DC Current Gain	h_{FE}	$V_{CE}=5V, I_C=0.5A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.5A$		3		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=2A, I_B=0.6A$			8	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=2A, I_B=0.6A$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5mA, I_E=0$	1500			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=5mA, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=5mA, I_C=0$	7			V
Storage Time	t_{stg}	$I_C=2A, I_{B1}=0.6A$			3.0	μs
Fall Time	t_f	$I_{B2}=-1.2A, R_L=100\Omega$			0.3	μs

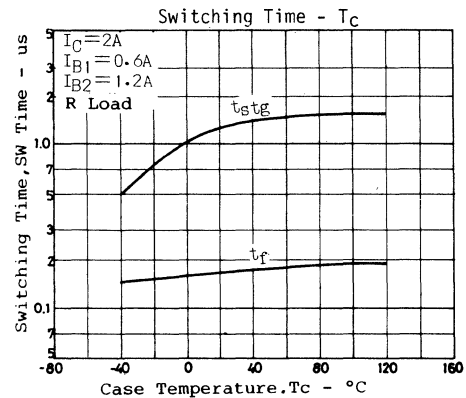
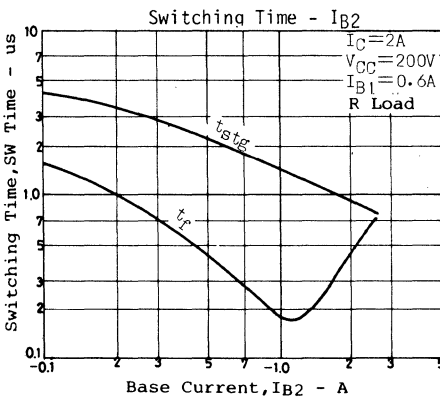
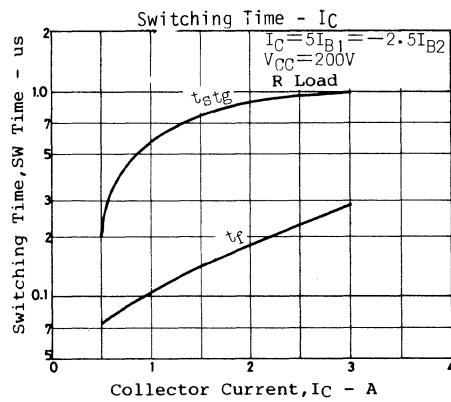
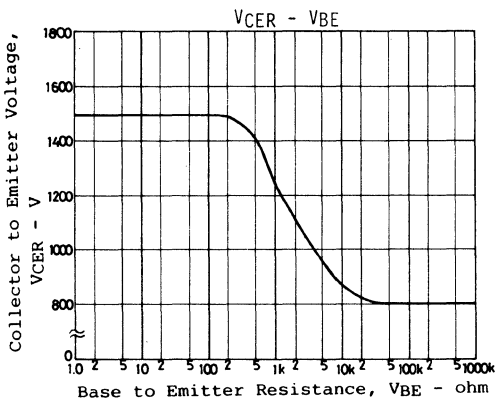
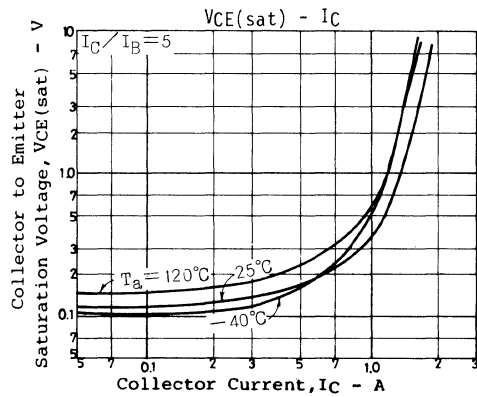
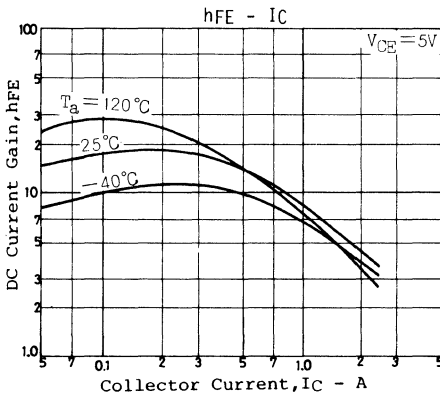
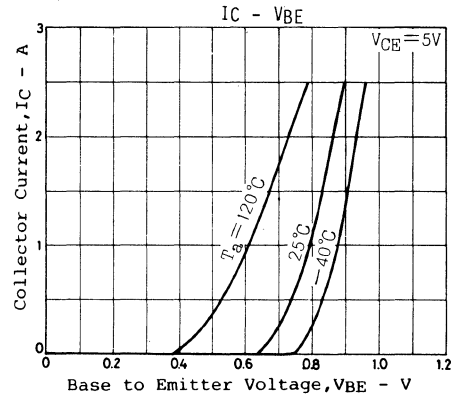
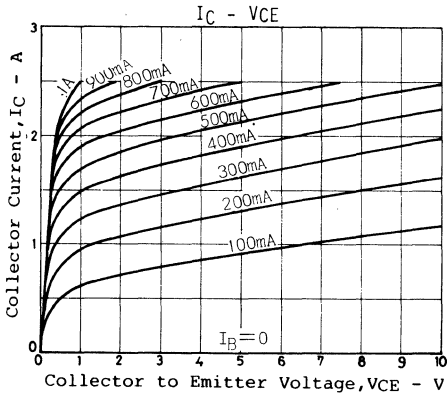
Switching Time Test Circuit

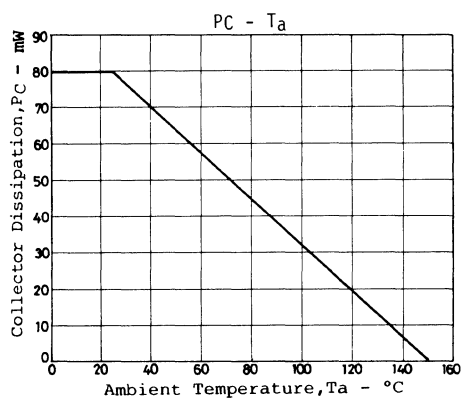
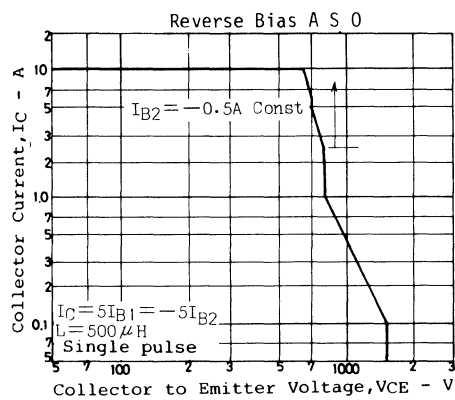
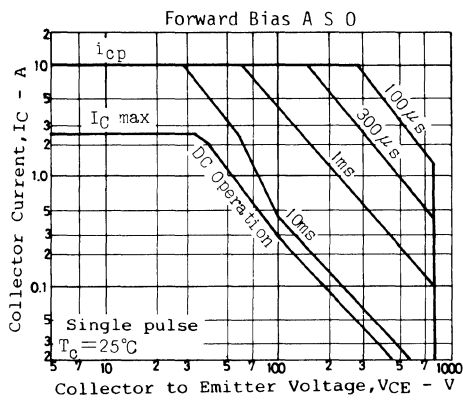
$PW=20\mu s$, Duty $\leq 1\%$



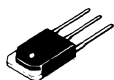
Case Outline 2022 (unit:mm)







2SC3484



2022

NPN Triple Diffused Planar
Silicon Transistor

High-Definition CRT Display Horizontal Deflection Output Applications

©1399

Features:

- High breakdown voltage and high reliability
- High switching speed: $t_f=0.3\mu s$ max.
- Capable of being mounted easily due to one-point fixing type plastics mold package

Absolute Maximum Ratings at $T_a=25^\circ C$

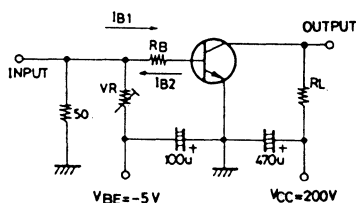
			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_C	3.5	A
Peak Collector Current	i_{cp}	10	A
Collector Dissipation	P_C	80	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a=25^\circ C$

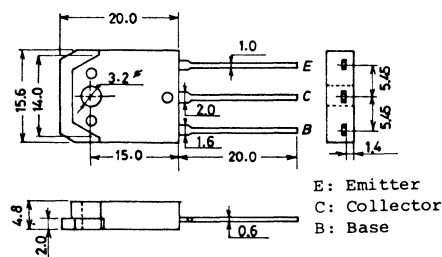
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			1	mA
DC Current Gain	h_{FE}	$V_{CE}=5V, I_C=0.5A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.5A$		3		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=2.5A, I_B=0.8A$			8	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=2.5A, I_B=0.8A$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5mA, I_E=0$	1500			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=5mA, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=5mA, I_C=0$	7			V
Storage Time	t_{stg}	$I_C=3A, I_{B1}=0.8A,$			3.0	μs
Fall Time	t_f	$I_{B2}=-1.6A,$ $R_L=66.7\Omega$			0.3	μs

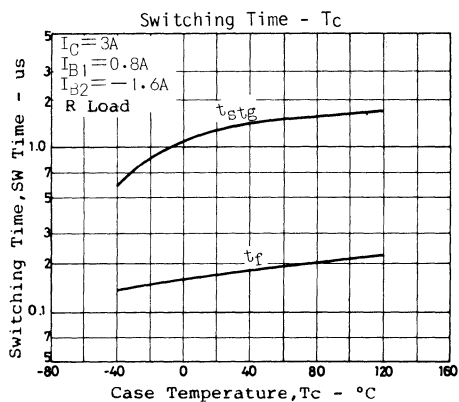
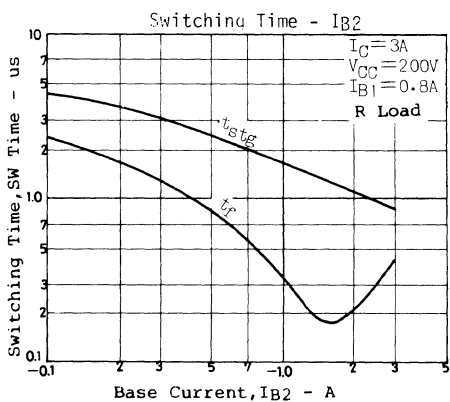
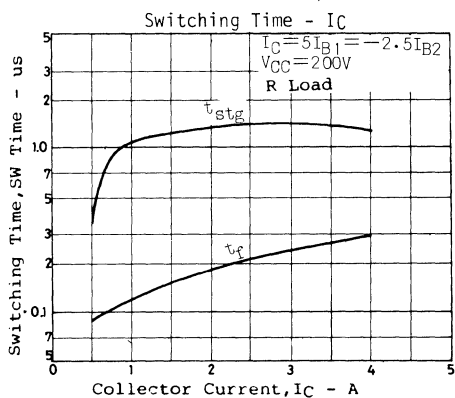
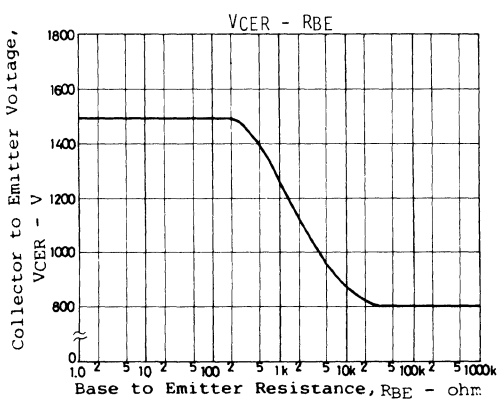
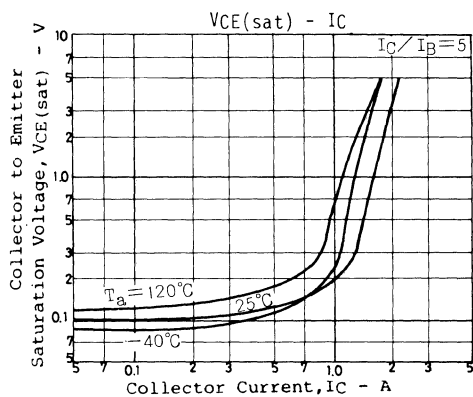
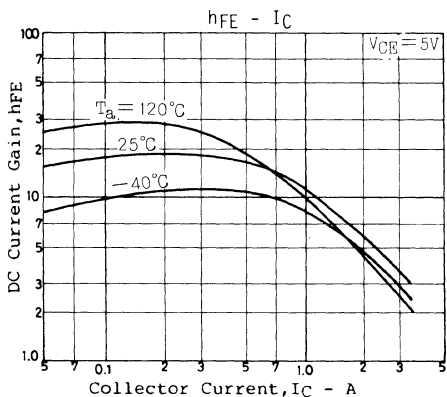
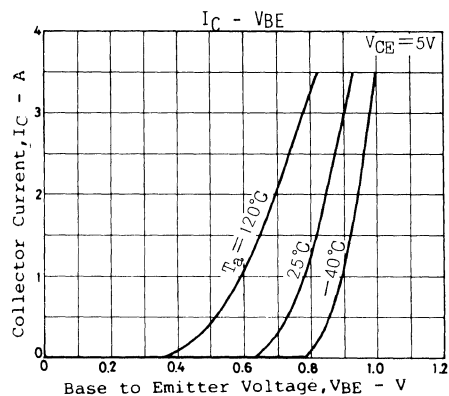
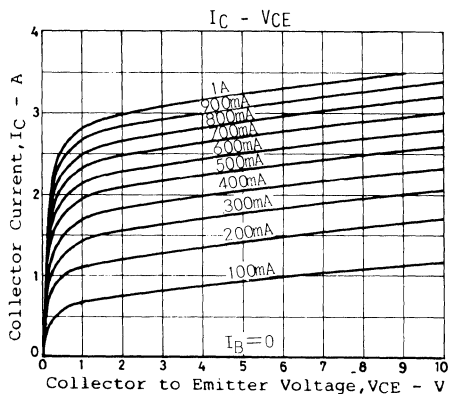
Switching Time Test Circuit

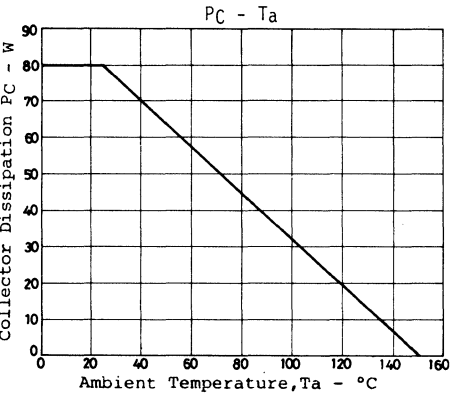
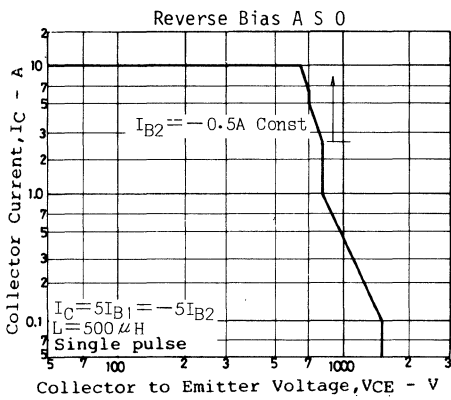
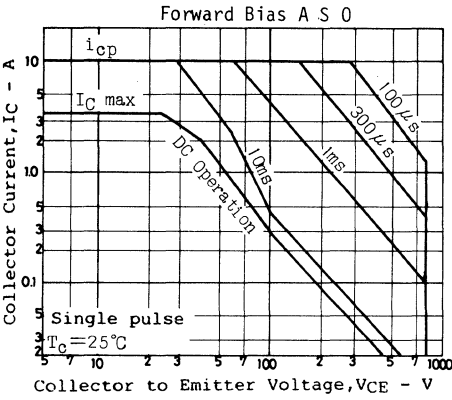
$PW=20\mu s, Duty \leq 1\%$



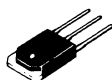
Case Outline 2022 (unit:mm)







2SC3485



2022

NPN Triple Diffused Planar
Silicon Transistor

High-Definition CRT Display Horizontal Deflection Output Applications

©1400

Features:

- High breakdown voltage and high reliability
- High switching speed: $t_f=0.3\mu s$ max.
- Capable of being mounted easily due to one-point fixing type plastic mold package

Absolute Maximum Ratings at $T_a=25^\circ C$

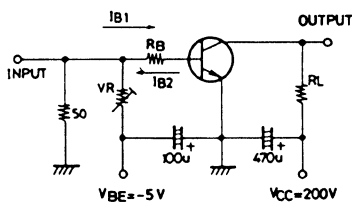
			unit
Collector to Base Voltage	V_{CB0}	1500	V
Collector to Emitter Voltage	V_{CE0}	800	V
Emitter to Base Voltage	V_{EB0}	7	V
Collector Current	I_C	5	A
Peak Collector Current	i_{cp}	16	A
Collector Dissipation	P_C	120	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a=25^\circ C$

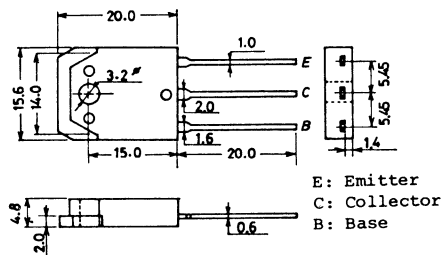
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			1	mA
DC Current gain	h_{FE}	$V_{CE}=5V, I_C=1A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=1A$		3		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=4A, I_B=1A$			5	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=4A, I_B=1A$			1.5	V
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C=5mA, I_E=0$	1500			V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_C=5mA, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E=5mA, I_C=0$	7			V
Storage Time	t_{stg}	$I_C=4A, I_{B1}=0.8A,$			3.0	μs
Fall Time	t_f	$I_{B2}=-1.6A,$ $R_L=50\Omega$			0.3	μs

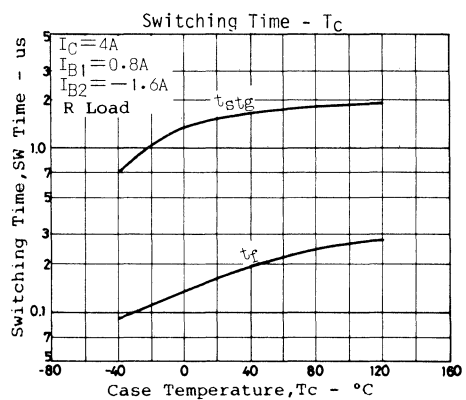
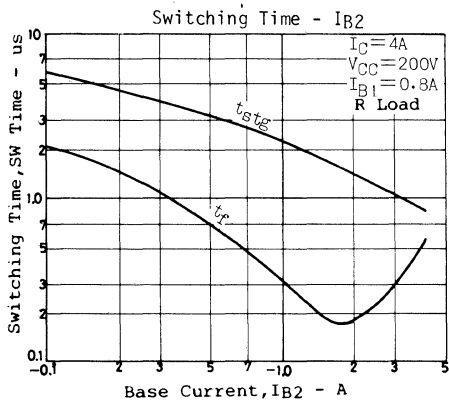
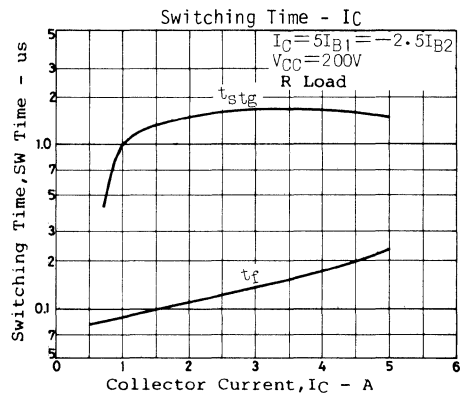
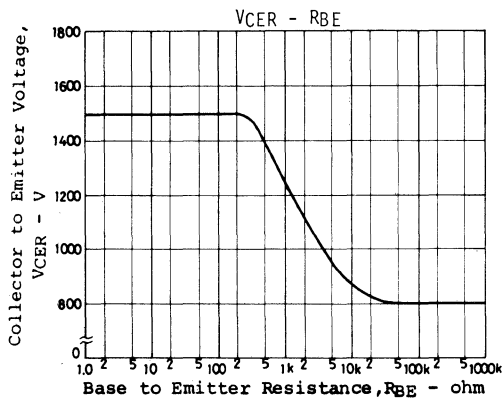
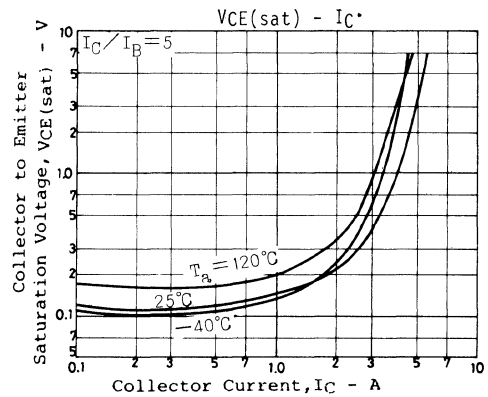
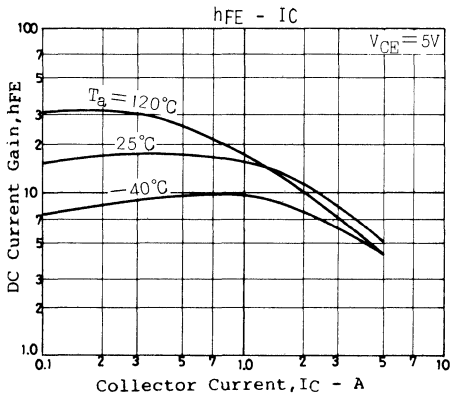
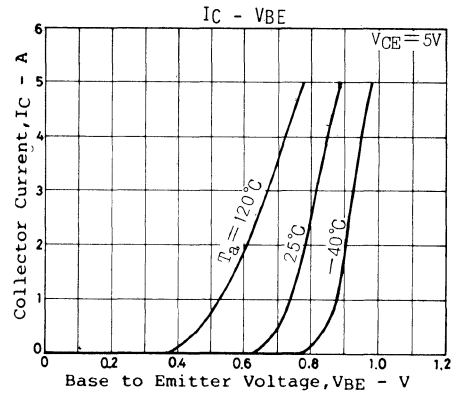
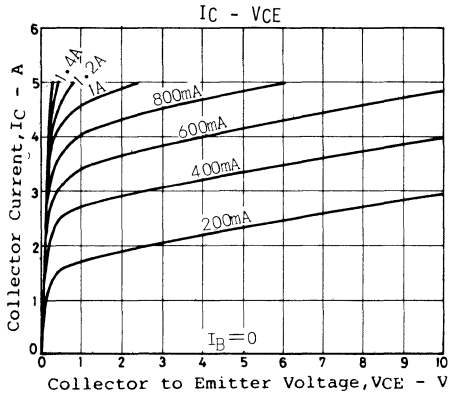
Switching Time Test Circuit

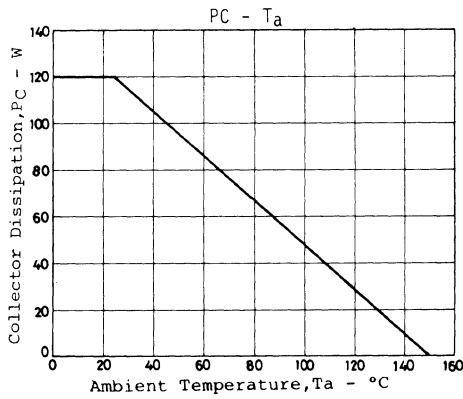
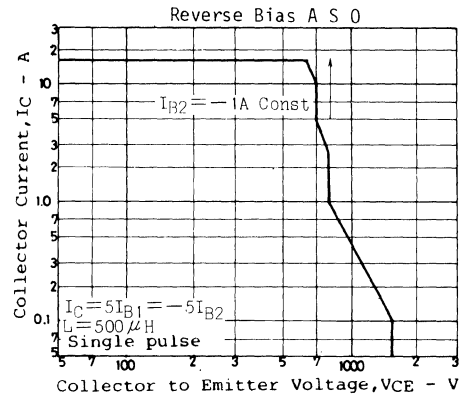
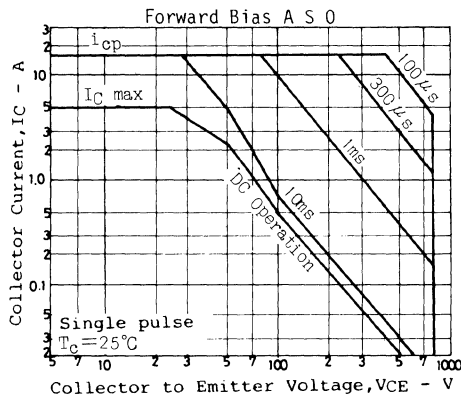
$PW=20\mu s, Duty \leq 1\%$



Case Outline 2022 (unit:mm)







2SC3486



2022

NPN Triple Diffused Planar
Silicon Transistor

High-Definition CRT Display Horizontal Deflection Output Applications

©1401

Features:

- High breakdown voltage and high reliability
- High switching speed : $t_f=0.3\mu s$ max.
- Capable of being mounted easily due to one-point fixing type plastic mold package

Absolute Maximum Ratings at $T_a=25^\circ C$

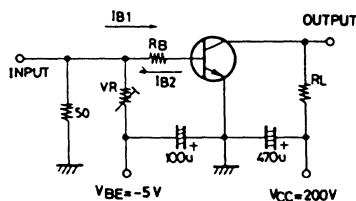
			unit
Collector to Base Voltage	VCBO	1500	V
Collector to Emitter Voltage	VCEO	800	V
Emitter to Base Voltage	VEBO	7	V
Collector Current	IC	6	A
Peak Collector Current	icp	16	A
Collector Dissipation	PC	120	W
Junction Temperature	Tj	150	°C
Storage Temperature	Tstg	-55 to +150	°C

Electrical Characteristics at $T_a=25^\circ C$

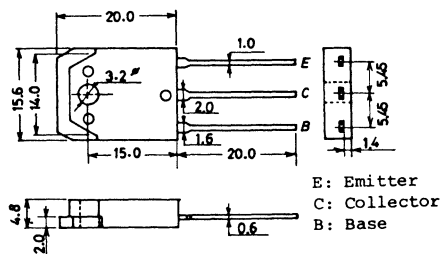
			min	typ	max	unit
Collector Cutoff Current	ICBO	VCB=800V, IE=0			10	uA
Emitter Cutoff Current	IEBO	VEB=5V, IC=0			1	mA
DC Current gain	hFE	VCE=5V, IC=1A	8			
Gain Bandwidth Product	fT	VCE=10V, IC=1A		3		MHz
C-E Saturation Voltage	VCE(sat)	IC=5A, IB=1.2A			5	V
B-E Saturation Voltage	VBE(sat)	IC=5A, IB=1.2A			1.5	V
C-B Breakdown Voltage	V(BR)CBO	IC=5mA, IE=0	1500			V
C-E Breakdown Voltage	V(BR)CEO	IC=5mA, RBE=∞	800			V
E-B Breakdown Voltage	V(BR)EBO	IE=5mA, IC=0	7			V
Storage Time	tstg	IC=5A, IB1=1A,			3.0	us
Fall Time	tf	IB2=-2A, RL=40ohm			0.3	us

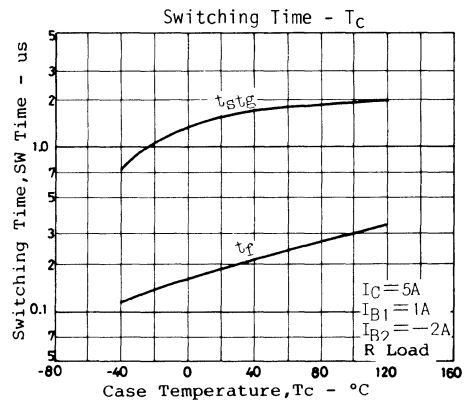
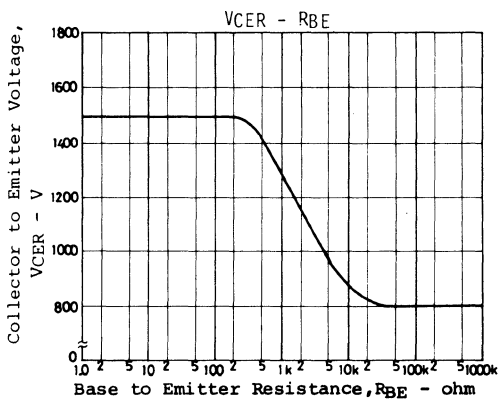
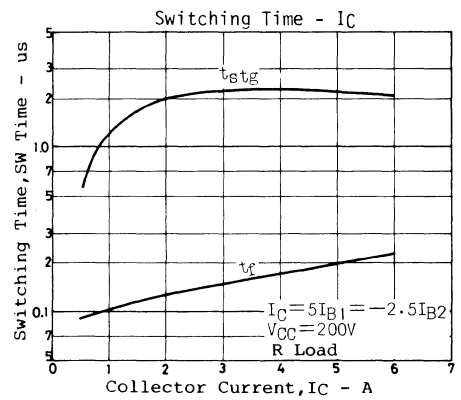
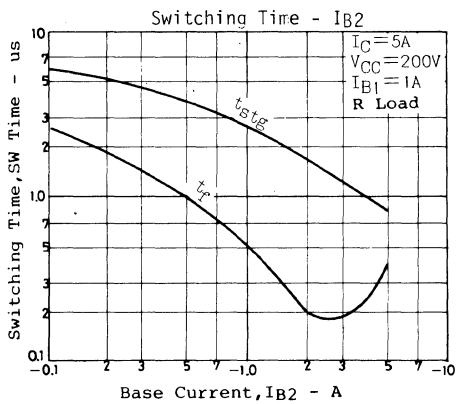
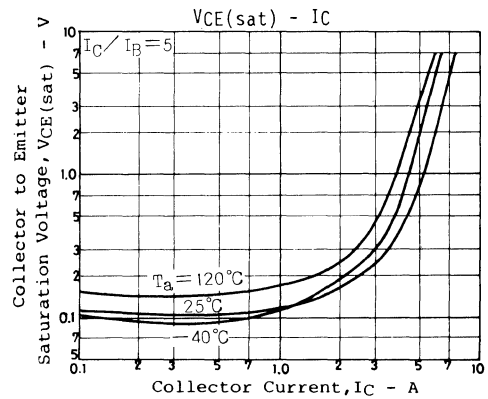
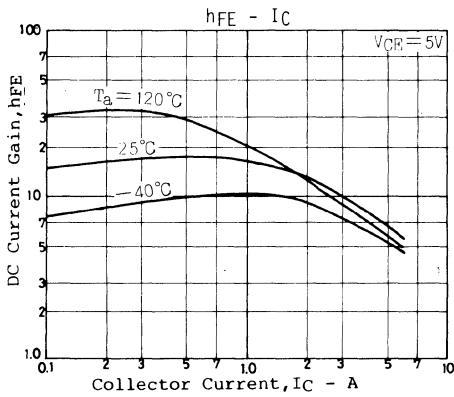
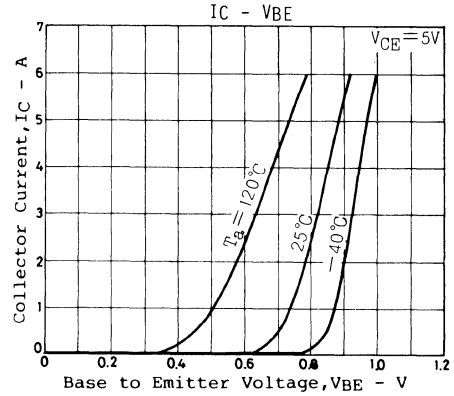
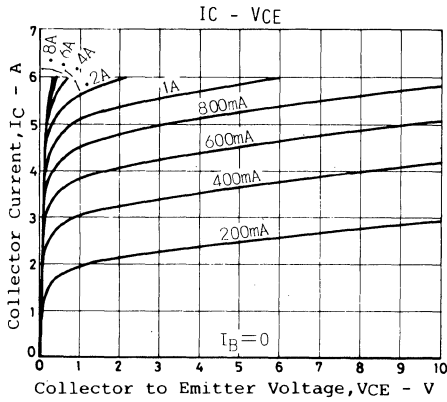
Switching Time Test Circuit

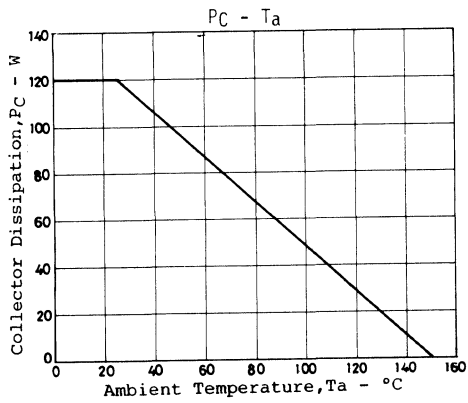
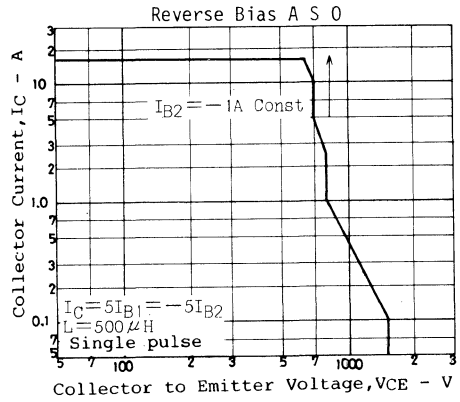
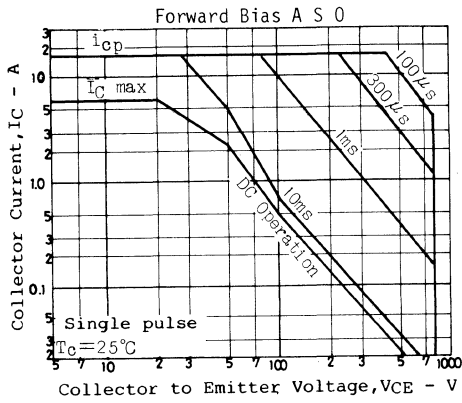
PW=20us, Duty≤1%



Case Outline 2022 (unit:mm)







2SC3495



2003A

NPN Epitaxial Planar
Silicon Transistor

High h_{FE} , Low Frequency, General-Purpose Amp Applications

Ⓔ1430

Use

- . AF amp, driver, muting circuit.

Features

- . Adoption of FBET process.
- . High DC current gain ($h_{FE}=500$ to 2000).
- . High breakdown voltage ($V_{CEO} \geq 100V$).
- . Low collector to emitter saturation voltage ($V_{CE(sat)} \leq 0.5V$).
- . High V_{EBO} ($V_{EBO} \geq 15V$).
- . Small c_{ob} ($c_{ob}=1.8pF$ typ).

Absolute Maximum Ratings at $T_a=25^{\circ}C$

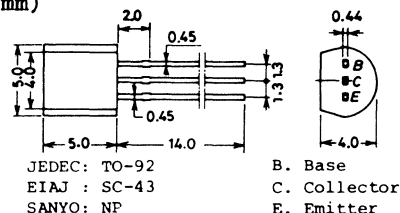
			unit
Collector to Base Voltage	V_{CBO}	120	V
Collector to Emitter Voltage	V_{CEO}	100	V
Emitter to Base Voltage	V_{EBO}	15	V
Collector Current	I_C	50	mA
Peak Collector Current	i_{cp}	100	mA
Collector Dissipation	P_C	500	mW
Junction Temperature	T_j	150	$^{\circ}C$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}C$

Electrical Characteristics at $T_a=25^{\circ}C$

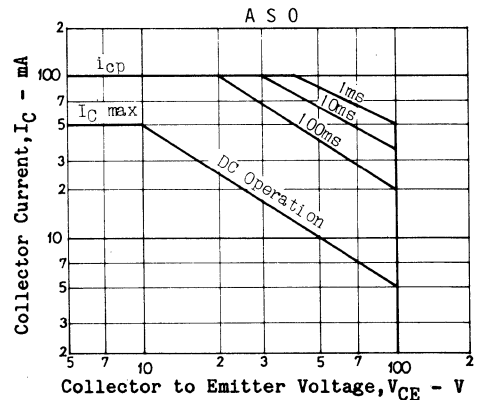
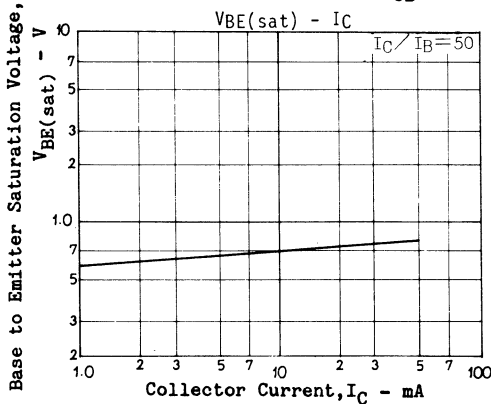
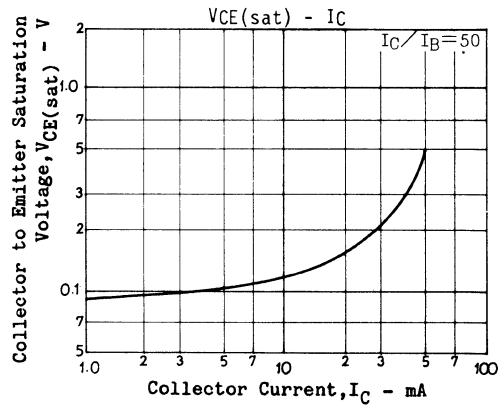
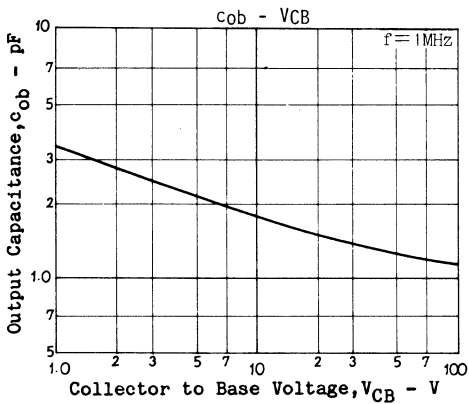
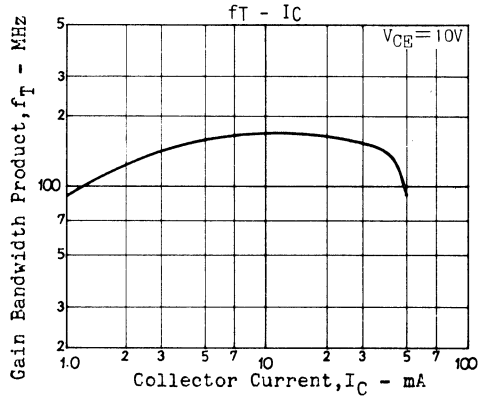
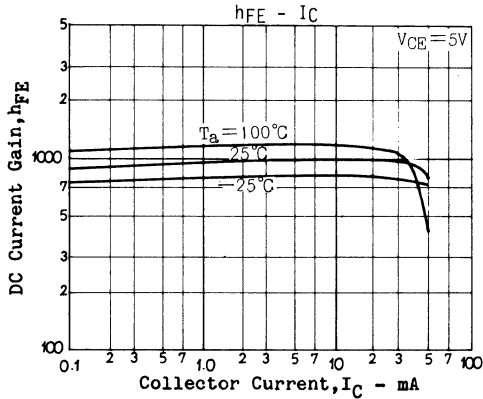
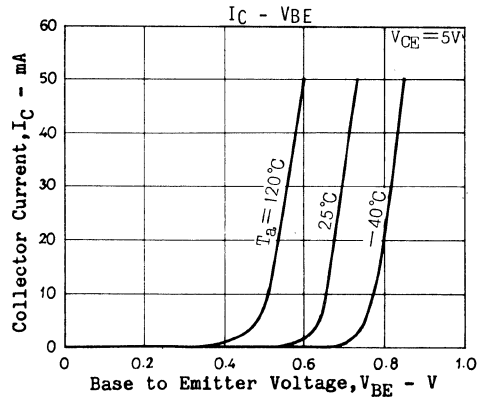
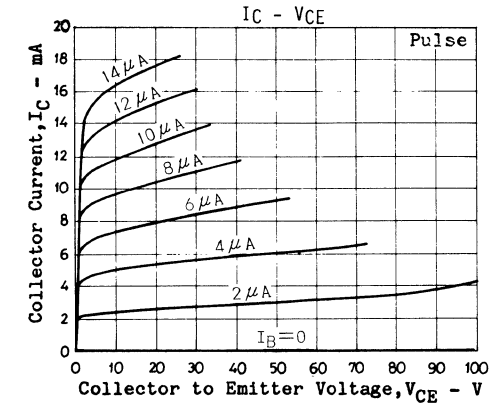
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=80V, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=10V, I_C=0$			0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=5V, I_C=10mA$	500	1000	2000	
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=10mA$		170		MHz
Output Capacitance	c_{ob}	$V_{CB}=10V, f=1MHz$		1.8		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=10mA, I_B=200\mu A$	0.1	0.5		V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=10mA, I_E=200\mu A$	0.7	1.0		V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu A, I_E=0$	120			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, I_B=0$	100			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu A, I_C=0$	15			V

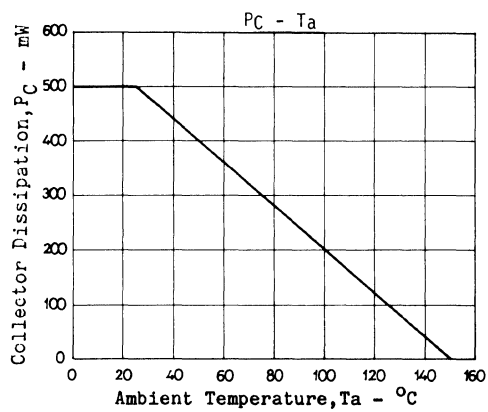
Case Outline 2003A

(unit:mm)



D174MY, TS No.1430-1/3





2SC3502



2009

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1380

High-Definition CRT Display Video Output Applications

©1425A

Features

- High breakdown voltage: $V_{CEO} \geq 200V$.
- Small reverse transfer capacitance and excellent high frequency characteristic $c_{re}=1.2pF(NPN)$, $1.7pF(PNP)$ $V_{CB}=30V$.
- Adoption of FBET process.

Absolute Maximum Ratings at $T_a=25^{\circ}C$

				unit
Collector to Base Voltage	V_{CBO}	(-)200	V	
Collector to Emitter Voltage	V_{CEO}	(-)200	V	
Emitter to Base Voltage	V_{EBO}	(-)5	V	
Collector Current	I_C	(-)100	mA	
Peak Collector Current	i_{cp}	(-)200	mA	
Allowable Collector Dissipation	P_C	1.2	W	
Junction Temperature	T_j	150	$^{\circ}C$	
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}C$	

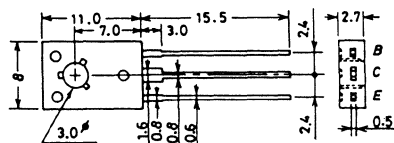
Electrical Characteristics at $T_a=25^{\circ}C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)150V, I_E=0$		(-)0.1	μA	
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$		(-)0.1	μA	
DC Current Gain	h_{FE}	$V_{CE}=(-)10V, I_C=(-)10mA$	40*		320*	
Gain Bandwidth Product	f_T	$V_{CE}=(-)30V, I_C=(-)10mA$		150		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)30V, f=1MHz$		1.7		pF
				(2.6)		
Reverse Transfer Capacitance	c_{re}	$V_{CB}=(-)30V, f=1MHz$		1.2		pF
				(1.7)		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)20mA, I_B=(-)2mA$		(-)0.6		V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)20mA, I_B=(-)2mA$		(-)1.0		V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	(-)200			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	(-)200			V
Base to Emitter Breakdown Voltage	$V_{(BR)EBO}$	$I_C=(-)10\mu A, I_C=0$	(-)5			V

* The 2SA1380/2SC3502 are classified by 10mA h_{FE} as follows:

40	C	80	60	D	120	100	E	200	160	F	320
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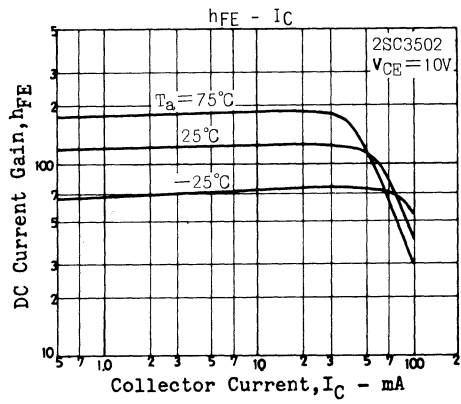
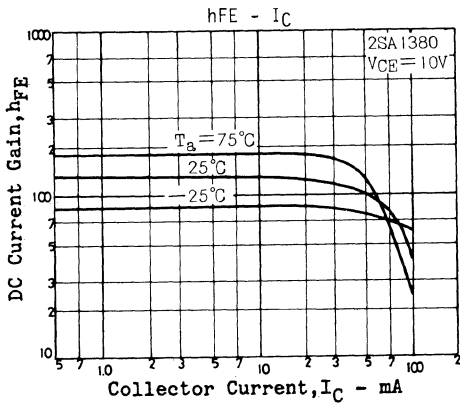
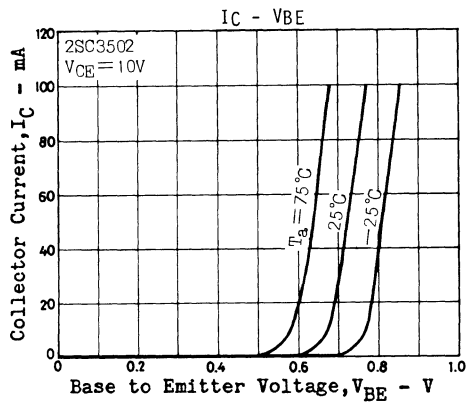
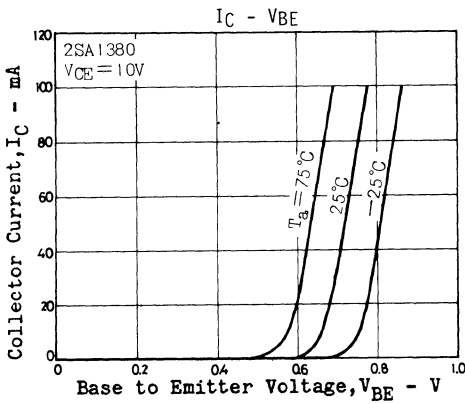
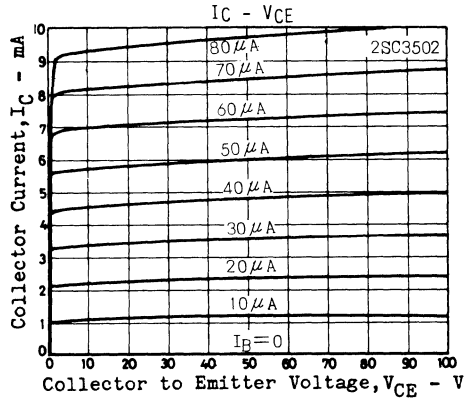
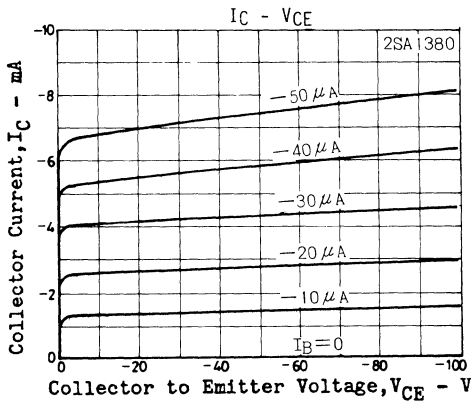
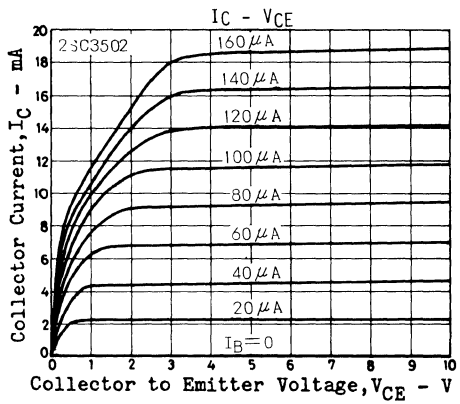
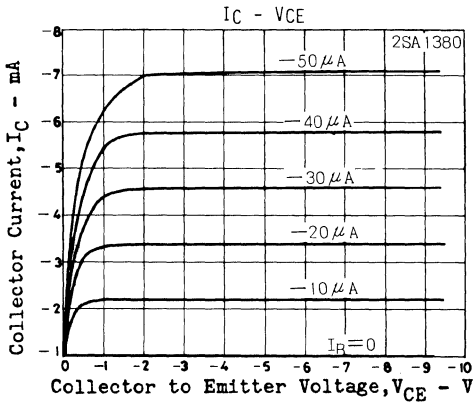
Case Outline 2009
(unit:mm)

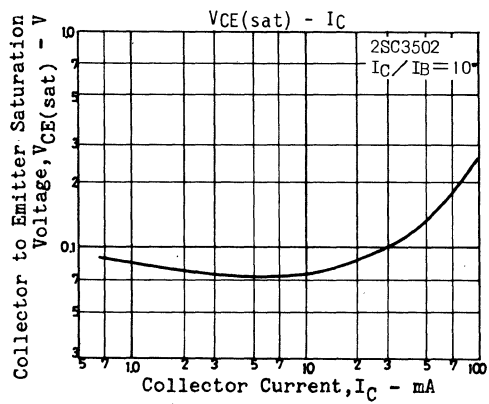
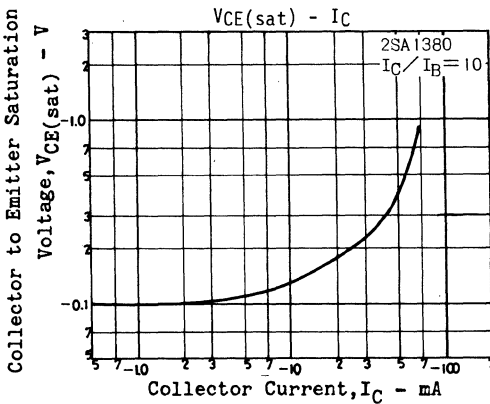
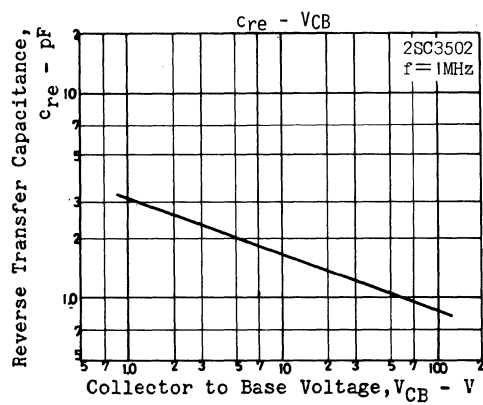
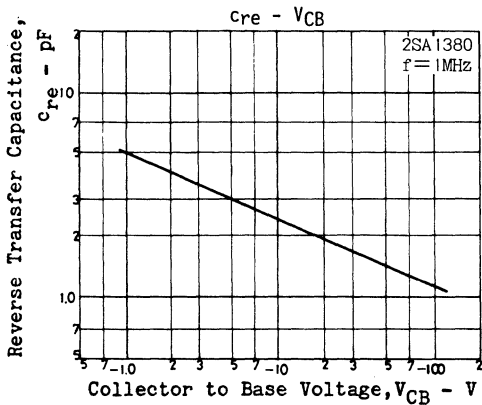
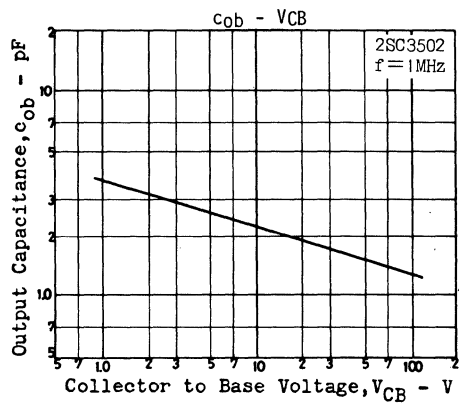
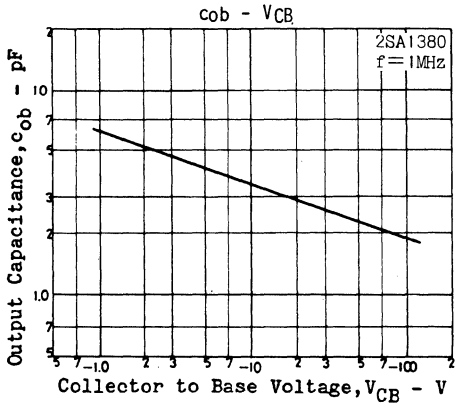
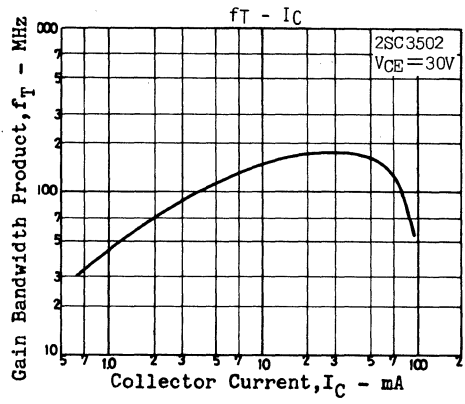
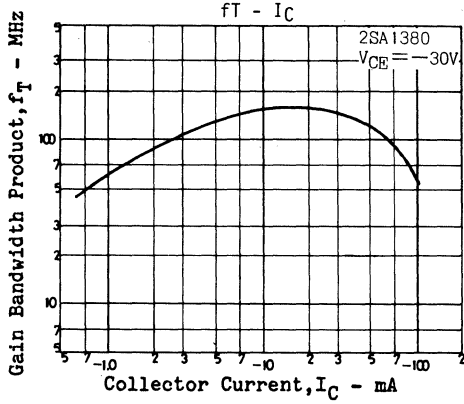


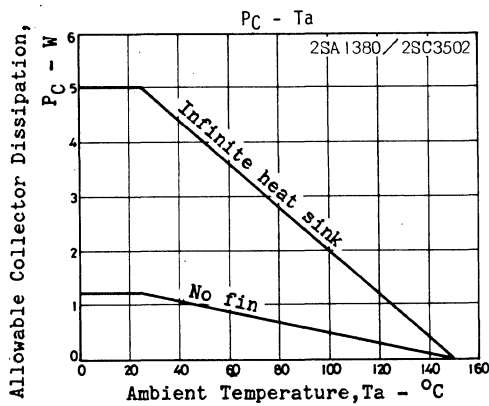
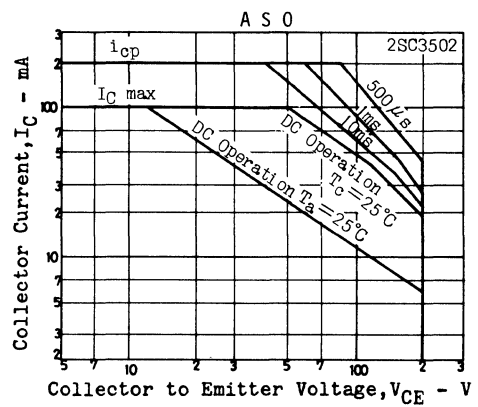
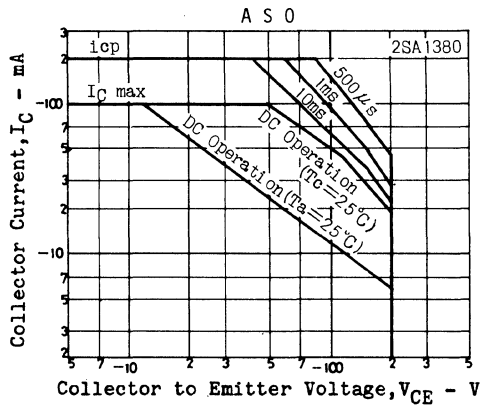
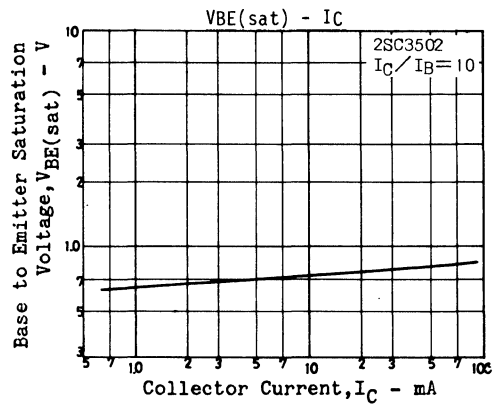
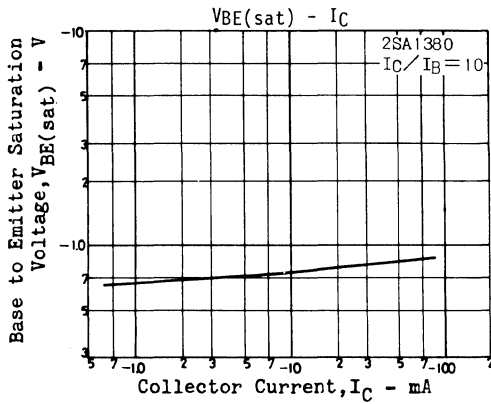
JEDEC: TO-126

B: Base
C: Collector
E: Emitter

D134MY, TS No.1425-1/4







2SC3503



2009

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1381

High-Definition CRT Display Video Output Applications

©1426A

Features

- High breakdown voltage: $V_{CEO} \geq 300V$.
- Small reverse transfer capacitance and excellent high frequency characteristic $c_{re} = 1.8pF$ (NPN), $2.3pF$ (PNP) $V_{CB} = 30V$.
- Adoption of MBIT process.

Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	(-)300	V
Collector to Emitter Voltage	V_{CEO}	(-)300	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Allowable Collector Dissipation	P_C	1.2	W
Junction Temperature	T_j	7	W
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

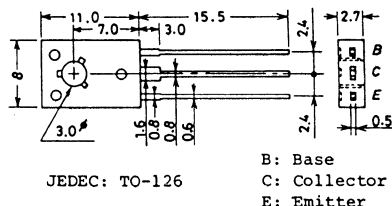
Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-)200V, I_E = 0$		(-)0.1		μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$		(-)0.1		μA
DC Current Gain	h_{FE}	$V_{CE} = (-)10V, I_C = (-)10mA$	40*		320*	
Gain Bandwidth Product	f_T	$V_{CE} = (-)30V, I_C = (-)10mA$		150		MHz
Output Capacitance	c_{ob}	$V_{CB} = (-)30V, f = 1MHz$		2.6		pF
				(3.1)		
Reverse Transfer Capacitance	c_{re}	$V_{CB} = (-)30V, f = 1MHz$		1.8		pF
				(2.3)		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = (-)20mA, I_B = (-)2mA$		(-)0.6		V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C = (-)20mA, I_B = (-)2mA$		(-)1.0		V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-)10\mu A, I_E = 0$	(-)300			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-)300			V
Base to Emitter Breakdown Voltage	$V_{(BR)EBO}$	$I_C = (-)10\mu A, I_C = 0$	(-)5			V

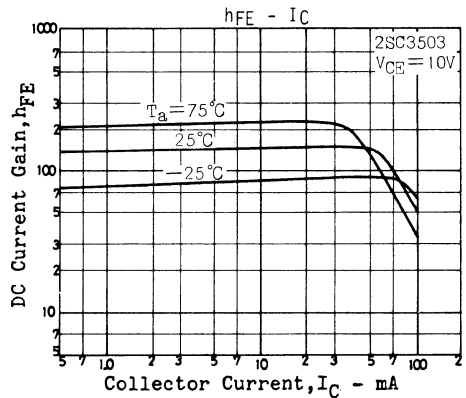
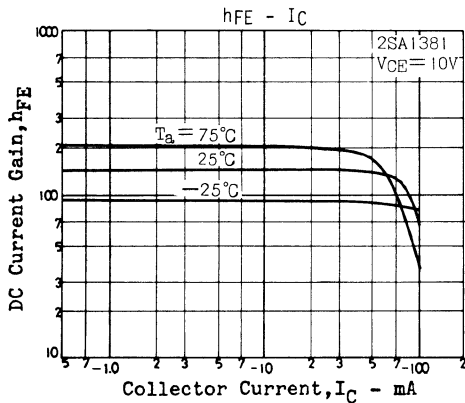
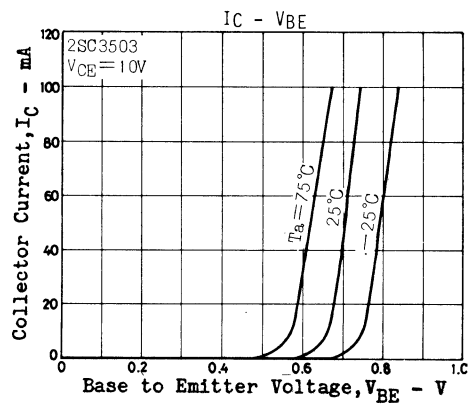
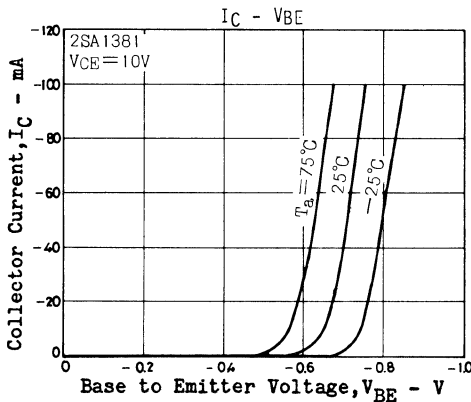
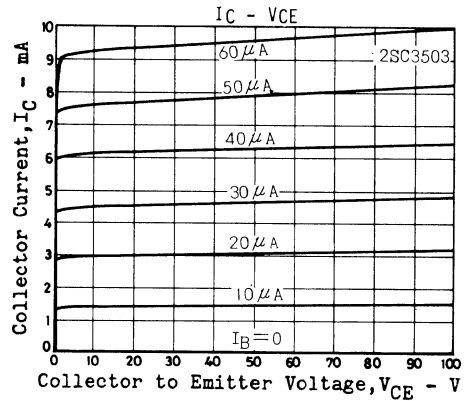
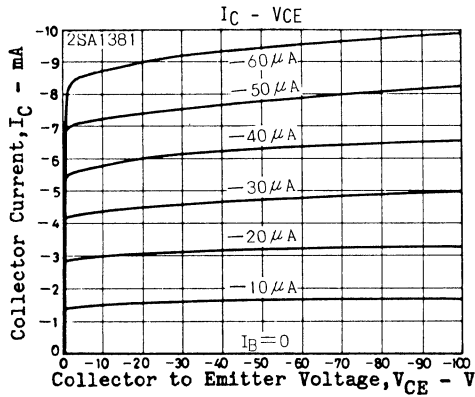
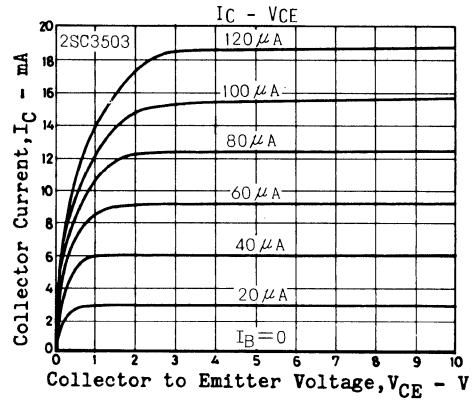
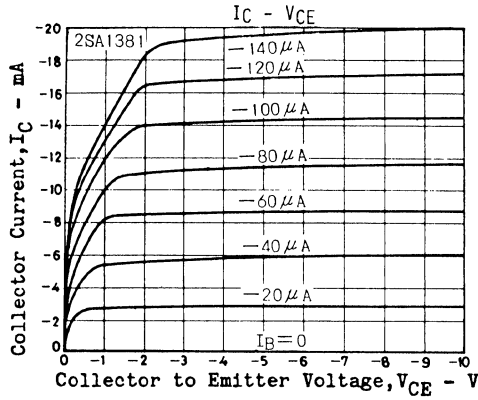
* The 2SA1381/2SC3503 are classified by 10mA h_{FE} as follows:

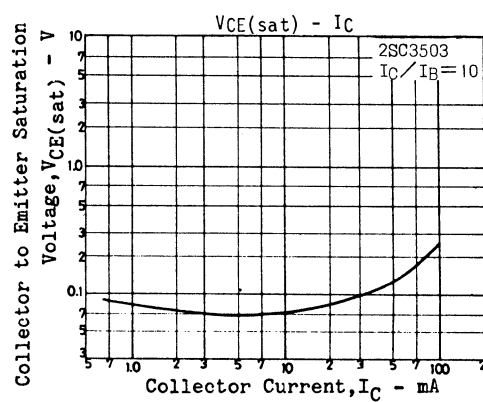
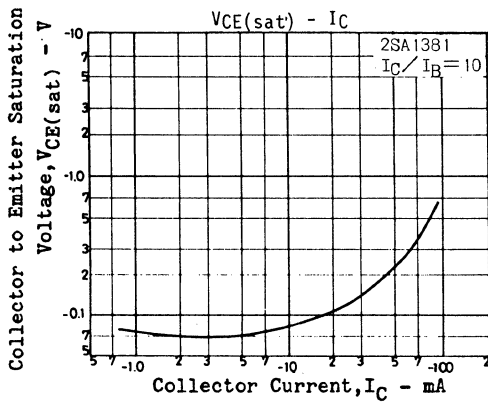
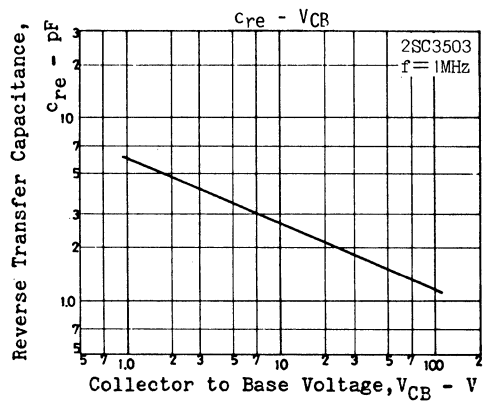
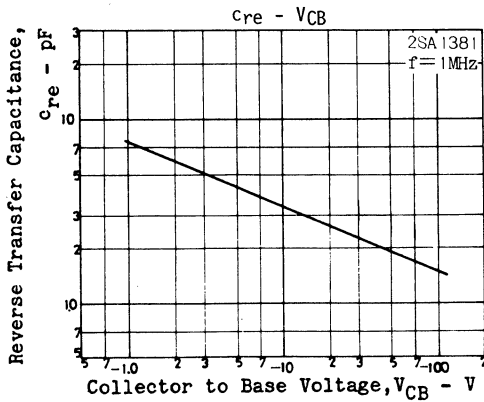
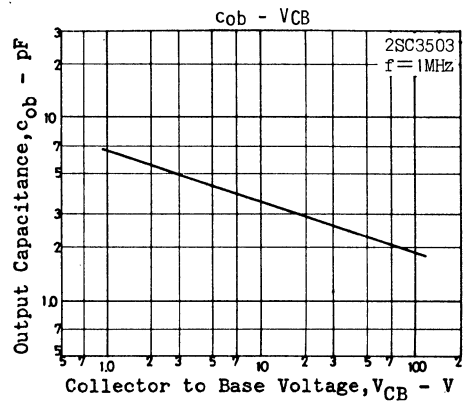
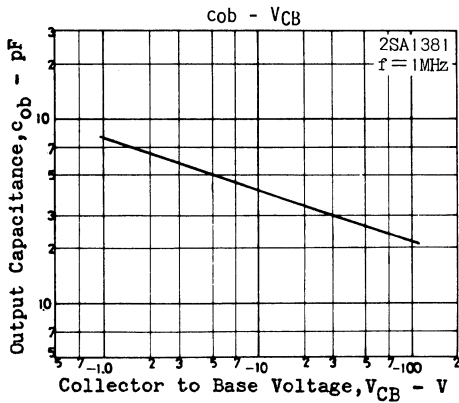
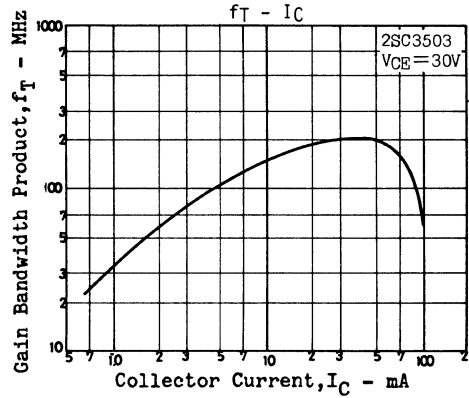
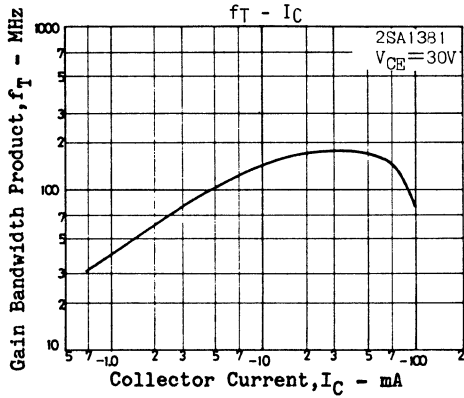
40	C	80	60	D	120	100	E	200	160	F	320
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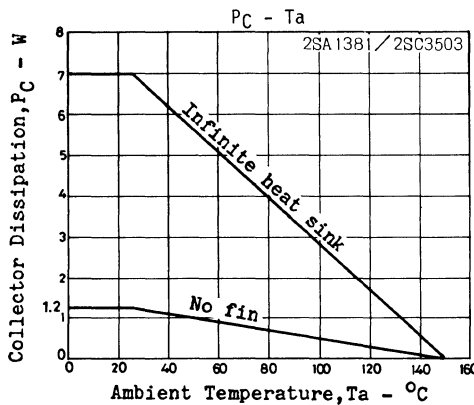
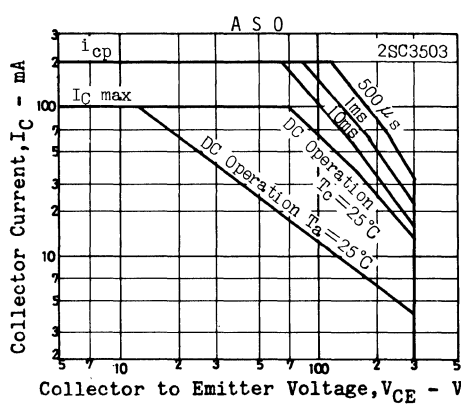
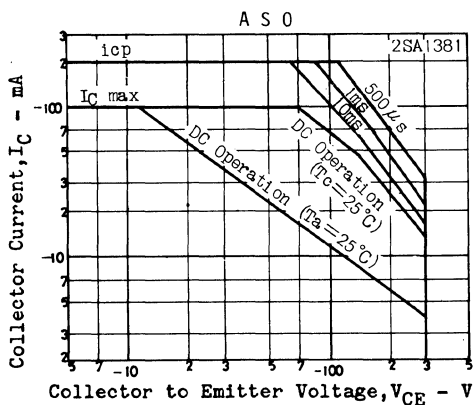
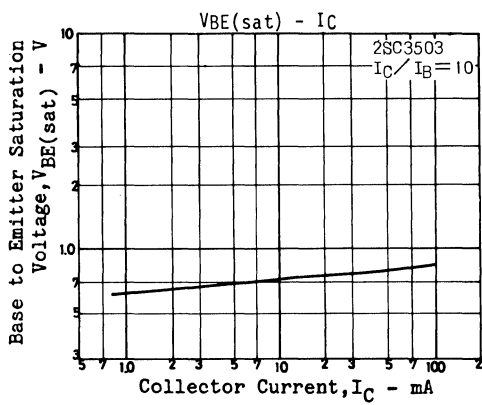
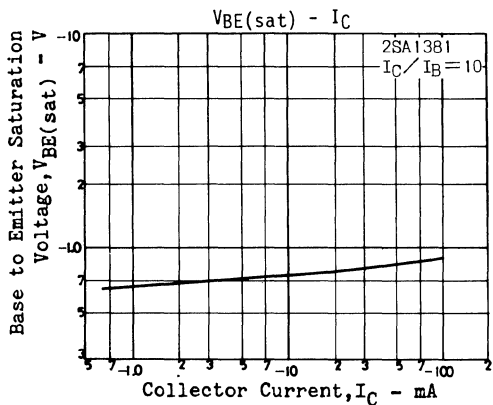
Case Outline 2009
(unit:mm)



D134MY, TS No.1426-1/4







2SC3504



2006A

NPN Epitaxial Planar
Silicon Transistor

High-Definition CRT Display Video Output Applications

©1438A

Features

- . High f_T .
- . Small reverse transfer capacitance.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	70	V
Collector to Emitter Voltage	V_{CE0}	60	V
Emitter to Base Voltage	V_{EBO}	4	V
Collector Current	I_C	50	mA
Peak Collector Current	i_{cp}	100	mA
Collector Dissipation	P_C	900	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

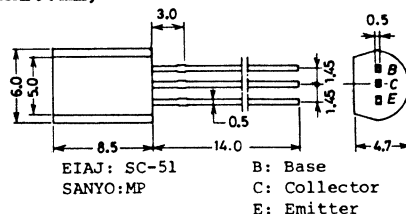
			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=40\text{V}, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=3\text{V}, I_C=0$			1.0	μA
DC Current Gain	h_{FE}	$V_{CE}=10\text{V}, I_C=10\text{mA}$	60*		320*	
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=10\text{mA}$	300	500		MHz
Collector to Base Time Constant	$r_{bb}'C_c$	$V_{CE}=10\text{V}, I_C=10\text{mA}$		8	20	ps
Reverse Transfer Capacitance	c_{re}	$V_{CB}=10\text{V}, f=1\text{MHz}$		1.0	1.6	pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=20\text{mA}, I_B=2\text{mA}$			0.5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=20\text{mA}, I_B=2\text{mA}$			1.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu\text{A}, I_E=0$	70			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1\text{mA}, R_{BE}=\infty$	60			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu\text{A}, I_C=0$	4			V

* The 2SC3504 is classified by 10mA h_{FE} as follows:

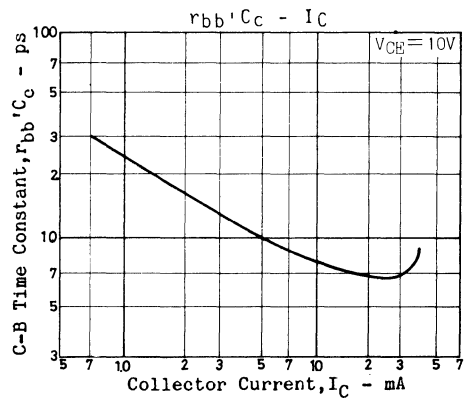
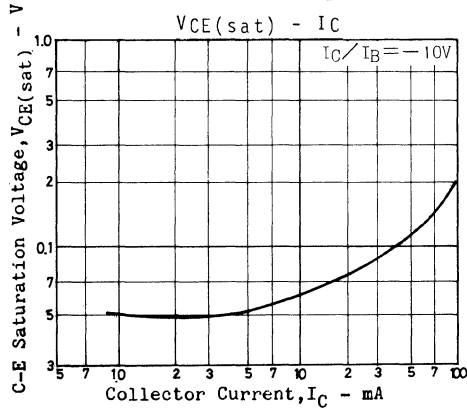
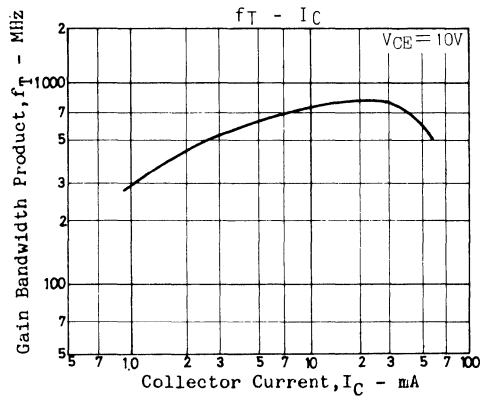
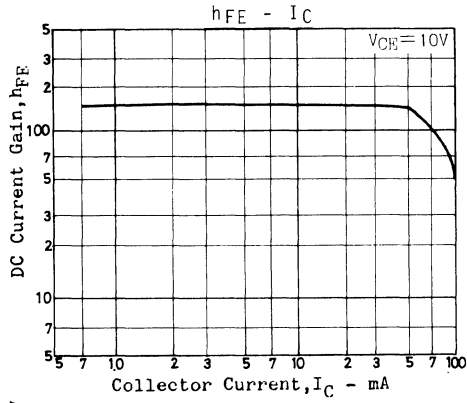
60	D	120	100	E	200	160	F	320
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Case Outline 2006A

(unit:mm)



3205KI, TS No.1438-1/2



2SC3552



2022

NPN Triple Diffused Planar
Silicon Transistor

Switching Regulator Applications

©1597A

Features

- . High breakdown voltage and high reliability.
- . Fast switching speed (t_f : 0.1us typ.)
- . Wide ASO.
- . Adoption of MBIT process.

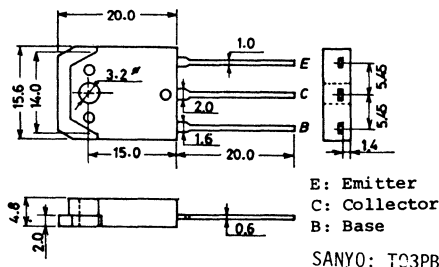
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	1100	V
Collector to Emitter Voltage	V_{CE0}	800	V
Emitter to Base Voltage	V_{EB0}	7	V
Collector Current	I_C	12	A
Peak Collector Current	i_{cp}	$PW \leq 300\mu s, \text{Duty Cycle} \leq 10\%$	
		30	A
Base Current	I_B	6	A
Collector Dissipation	P_C	$T_C=25^\circ\text{C}$	
		150	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	
			$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

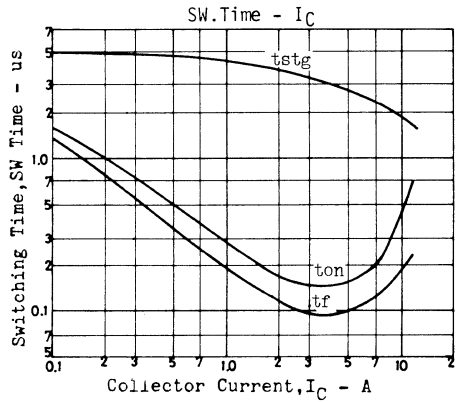
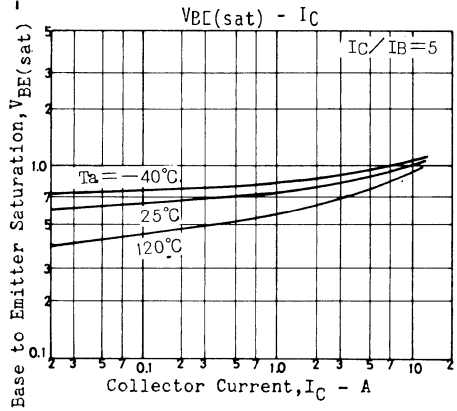
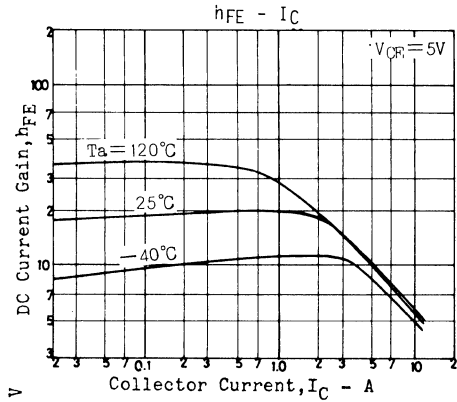
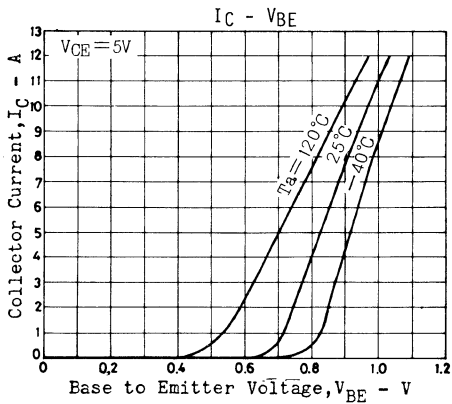
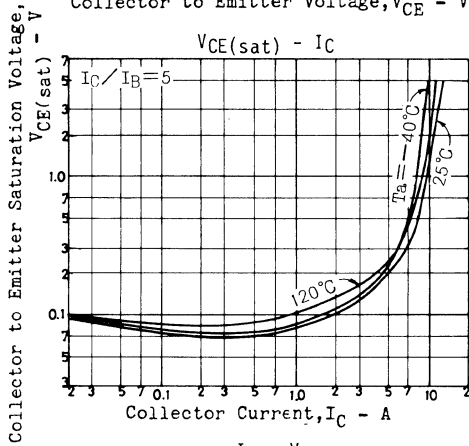
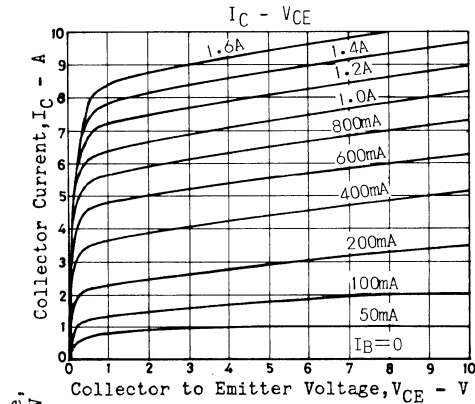
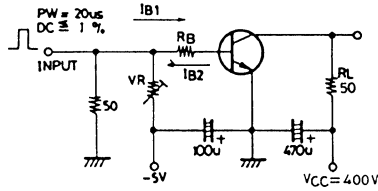
			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=800V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=5V, I_C=0$			10	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5V, I_C=0.8A$	10			
	$h_{FE}(2)$	$V_{CE}=5V, I_C=4A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.8A$		15		MHz
Output Capacitance	c_{ob}	$V_{CB}=10V, f=1\text{MHz}$		215		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=6A, I_B=1.2A$			2.0	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=6A, I_B=1.2A$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1mA, I_E=0$	1100			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=5mA, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1mA, I_C=0$	7			V
C-E Sustain Voltage	$V_{CEX(sus)}$	$I_C=6A$	800			V
Turn-On Time	t_{on}	$I_{B1}=-I_{B2}=1.2A, L=500\mu H, \text{Clamped}$			0.5	us
Storage Time	t_{stg}	$V_{CC}=400V, 5I_{B2}=-2.5I_{B2}=I_C=8A,$			3.0	us
Fall Time	t_f	$R_L=50\Omega$			0.3	us

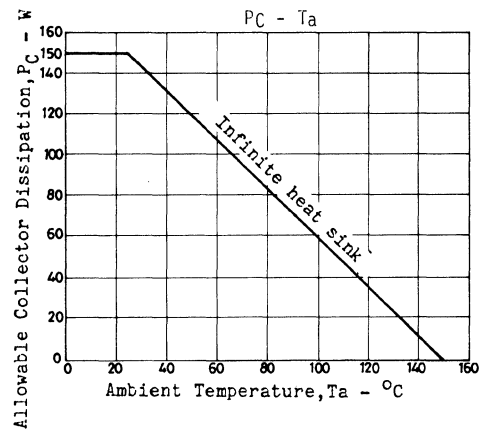
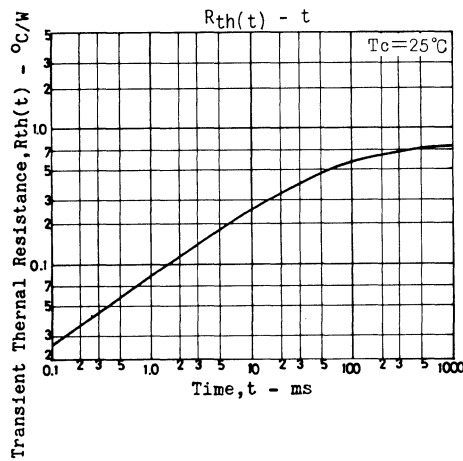
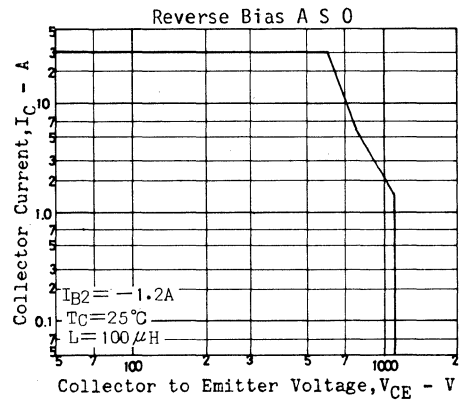
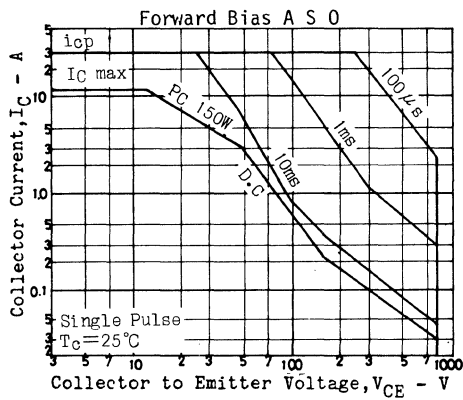
Case Outline 2022 (unit:mm)



3095KI/D054KI, TS No.1597-1/3

Switching Time Test Circuit





2SC3576



2033

NPN Epitaxial Planar
Silicon Transistor

High h_{FE} , Low Frequency, General-Purpose Amp Applications

©1799

Applications

- . LF general-purpose amplifiers, various drivers, muting circuit

Features

- . Adoption of FBET process
- . High DC current gain ($h_{FE}=800$ to 3000).
- . Low collector-to-emitter saturation voltage ($V_{CE(sat)} \leq 0.5V$).
- . High V_{EBO} ($V_{EBO} \geq 15V$).

Absolute Maximum Ratings at $T_a=25^\circ C$

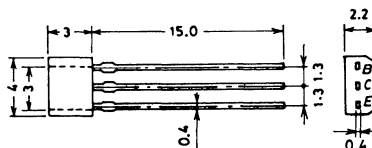
			unit
Collector to Base Voltage	V_{CBO}	30	V
Collector to Emitter Voltage	V_{CEO}	25	V
Emitter to Base Current	V_{EBO}	15	V
Collector Current	I_C	300	mA
Peak Collector Current	i_{cp}	500	mA
Collector Dissipation	P_C	300	mW
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a=25^\circ C$

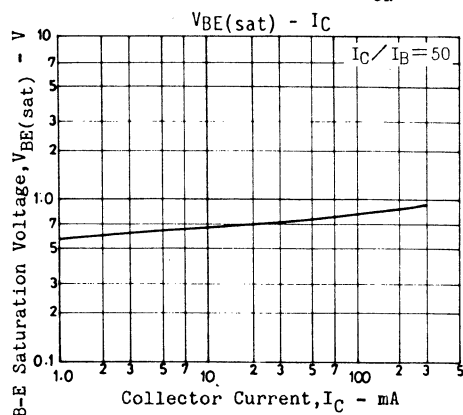
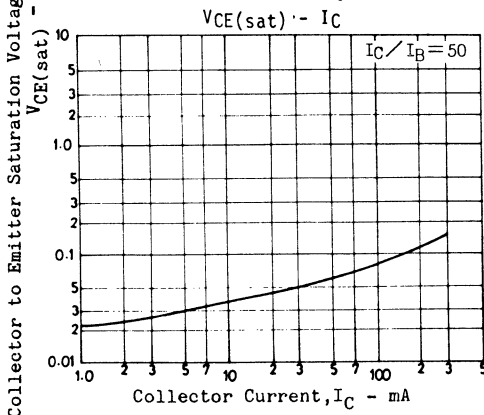
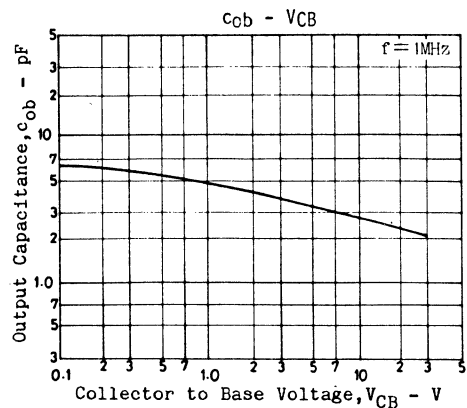
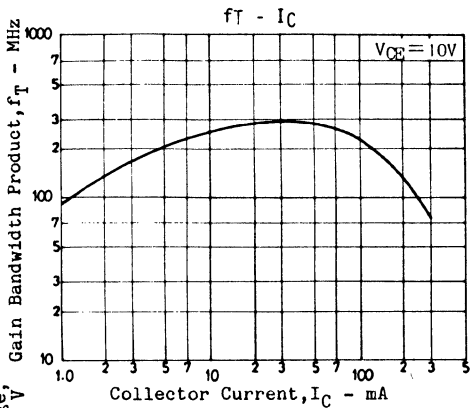
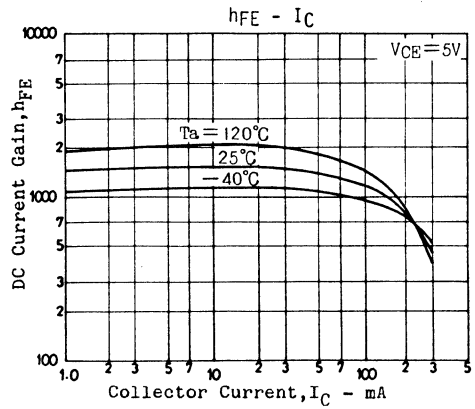
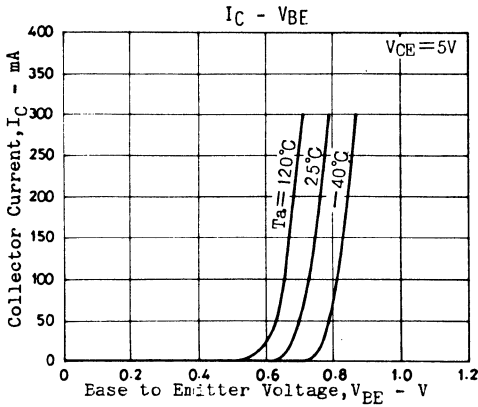
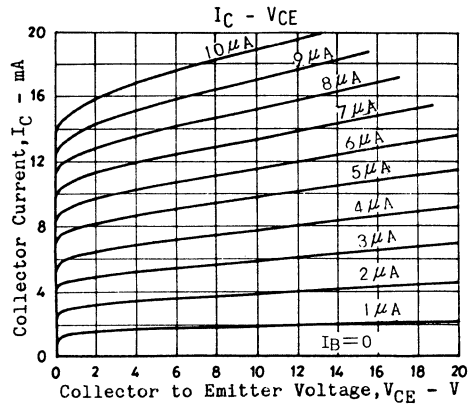
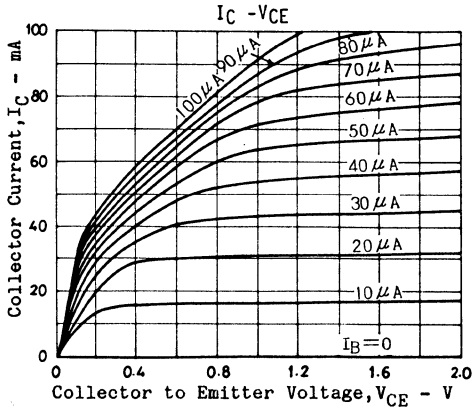
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=20V, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=10V, I_C=0$			0.1	μA
DC Current Gain	h_{FE}	$V_{CE}=5V, I_C=10mA$	800	1500	3200	
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=10mA$		250		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=200mA, I_B=4mA$	0.12	0.5		V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=200mA, I_B=4mA$	0.85	1.2		V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu A, I_E=0$	30			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, I_B=0$	25			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu A, I_C=0$	15			V
Output Capacitance	c_{ob}	$V_{CB}=10V, f=1MHz$		2.7		pF

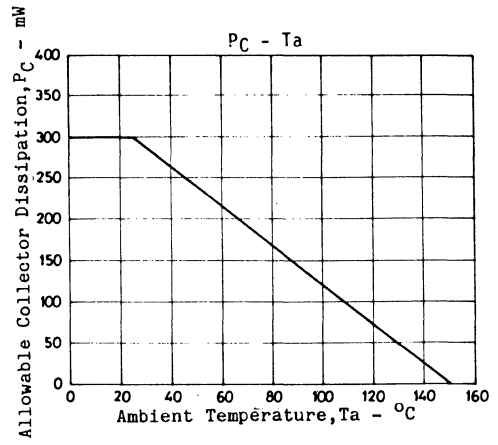
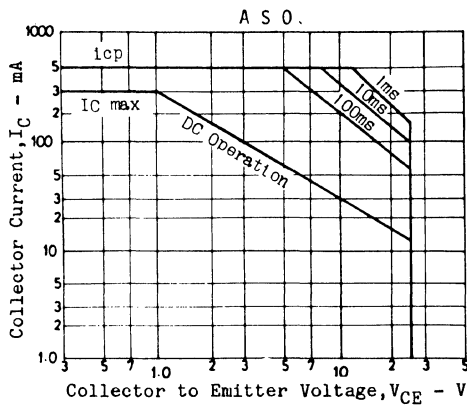
Case Outline 2033

(unit:mm)

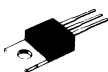


B: Base
C: Collector
E: Emitter
SANYO: SPA





2SC3589



2010A

NPN Triple Diffused Planar
Silicon Transistor

High-Definition CRT Display Horizontal Deflection Output Applications

©1607A

Use

- . AC/DC power supply.
- . CRT display horizontal deflection output.

Features

- . Fast switching speed.
- . Low $V_{CE(sat)}$
- . Adoption of MBIT process.

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	250	V
Collector to Emitter Voltage	V_{CEO}	100	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	7	A
Peak Collector Current	i_{cp}	15	A
Base Current	I_B	3	A
Collector Dissipation	P_C	40	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

$T_C=25^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

		min	typ	max	unit
Collector Cutoff Current	I_{CBO}			100	μA
Emitter Cutoff Current	I_{EBO}			100	μA
DC Current Gain	$h_{FE(1)}$	30		160	
	$h_{FE(2)}$	15		75	
Gain Bandwidth Product	f_T		10		MHz
C-E Saturation Voltage	$V_{CE(sat)}$			0.8	V
B-E Saturation Voltage	$V_{BE(sat)}$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	250			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	100			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	6.0			V
Fall Time	t_f			0.3	μs

$V_{CB}=150\text{V}, I_E=0$

$V_{EB}=5\text{V}, I_C=0$

$V_{CE}=1\text{V}, I_C=1\text{A}$

$V_{CE}=1\text{V}, I_C=5\text{A}$

$V_{CE}=5\text{V}, I_C=1\text{A}$

$I_C=5\text{A}, I_B=0.5\text{A}$

$I_C=5\text{A}, I_B=0.5\text{A}$

$I_C=1\text{mA}, I_E=0$

$I_C=1\text{mA}, R_{BE}=\infty$

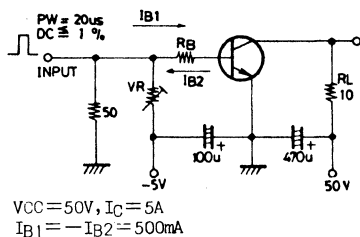
$I_E=1\text{mA}, I_C=0$

At specified test

circuit, $I_C=5\text{A}$,

$I_{B1}=0.5\text{A}, I_{B2}=-0.5\text{A}$

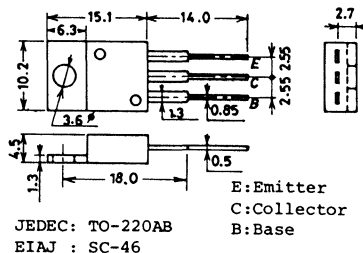
Specified Test Circuit



$V_{CC}=50\text{V}, I_C=5\text{A}$
 $I_{B1}=-I_{B2}=500\text{mA}$

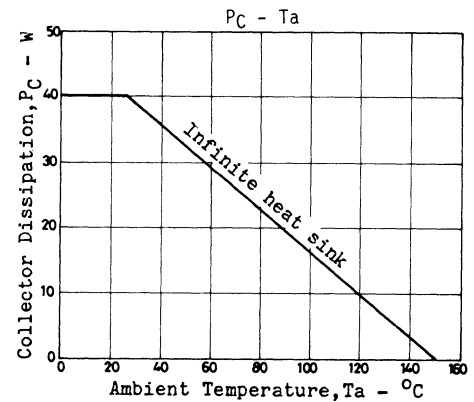
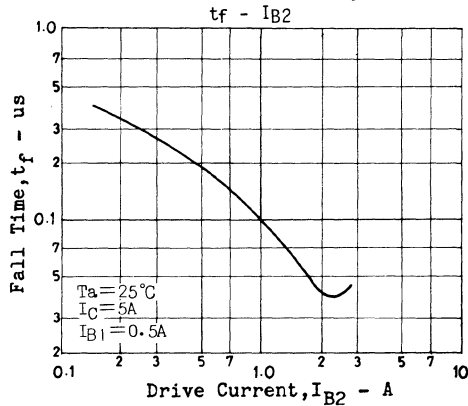
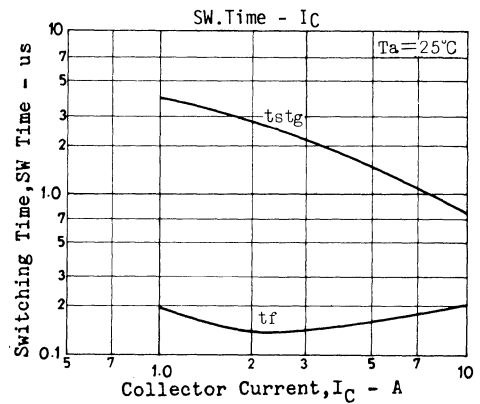
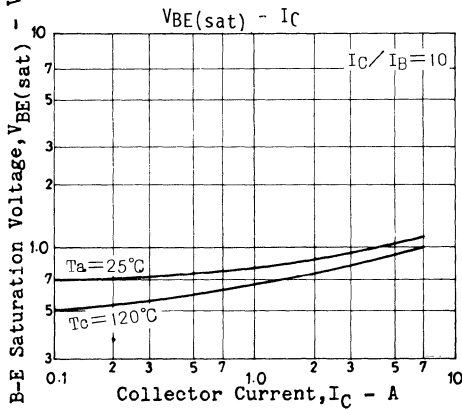
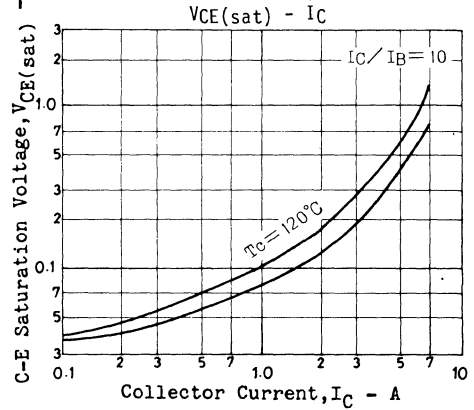
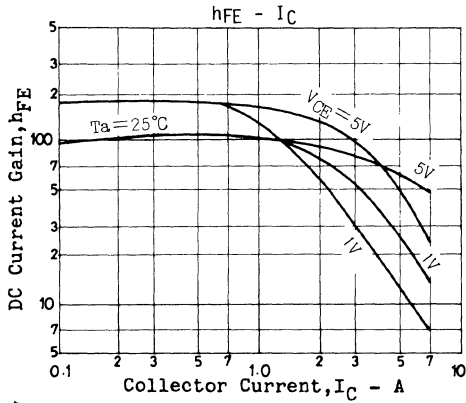
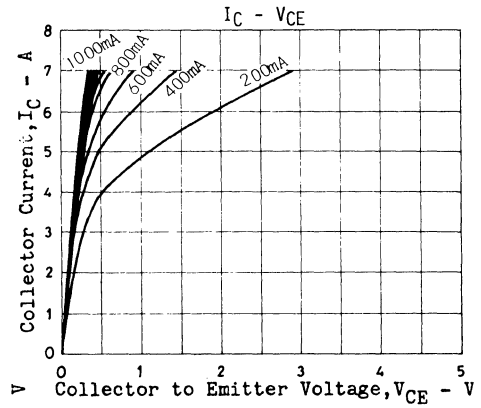
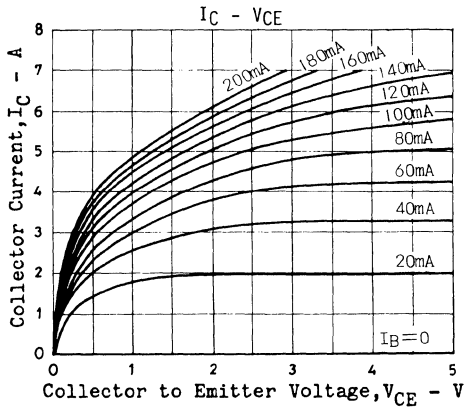
Case Outline 2010A

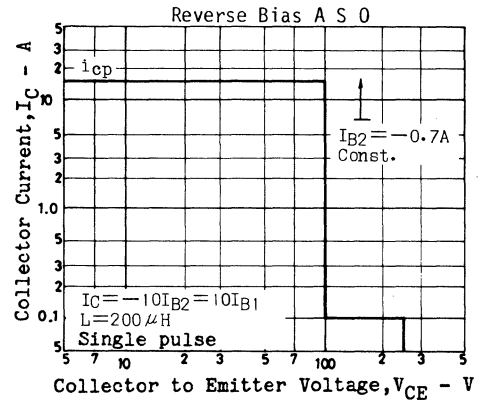
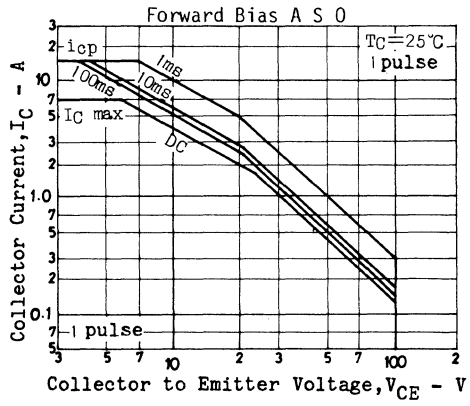
(unit:mm)



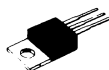
E:Emitter
C:Collector
B:Base

JEDEC: TO-220AB
EIAJ: SC-46





2SC3590



2010A

NPN Epitaxial Planar
Silicon Transistor

High-Definition CRT Display Horizontal Deflection Output Applications

©1608A

Features

- . Fast switching speed.
- . Low saturation voltage.
- . Adoption of MBIT process.

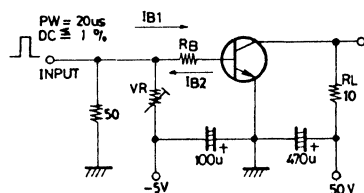
Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	300	V
Collector to Emitter Voltage	V_{CE0}	150	V
Emitter to Base Voltage	V_{EB0}	6	V
Collector Current	I_C	7	A
Peak Collector Current	i_{cp}	12	A
Base Current	I_B	4	A
Collector Dissipation	P_C	50	W
Junction Temperature	T_J	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

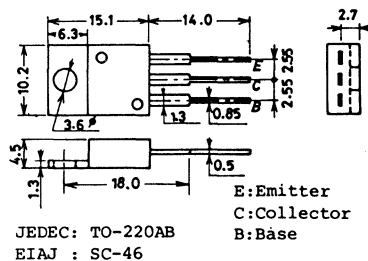
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=180\text{V}, I_E=0$			100	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5\text{V}, I_C=0$			100	μA
DC Current Gain	$h_{FE(1)}$	$V_{CE}=1\text{V}, I_C=1\text{A}$	15			
	$h_{FE(2)}$	$V_{CE}=1\text{V}, I_C=5\text{A}$	10		50	
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=0.5\text{A}$	10	40		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=5\text{A}, I_B=0.5\text{A}$			0.8	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=5\text{A}, I_B=0.5\text{A}$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1\text{mA}, I_E=0$	330			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1\text{mA}, R_{BE}=\infty$	150			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1\text{mA}, I_C=0$	6			V
Fall Time	t_f	At specified test circuit, $I_C=5\text{A}$, $I_{B1}=-I_{B2}=-0.5\text{A}$			0.3	μs

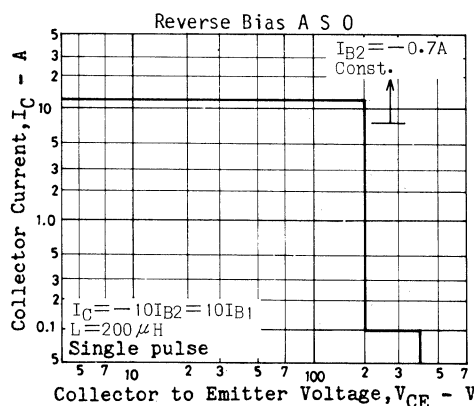
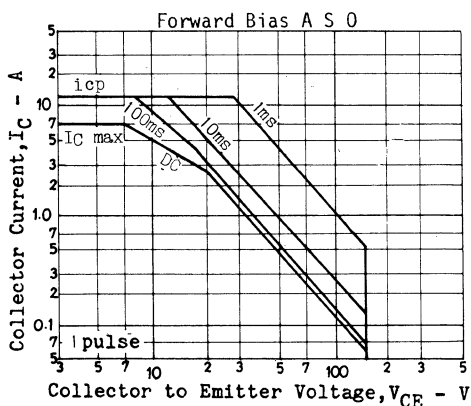
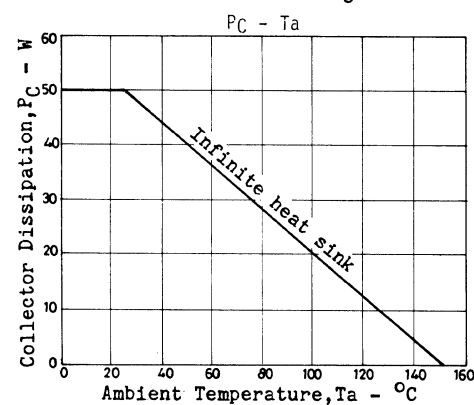
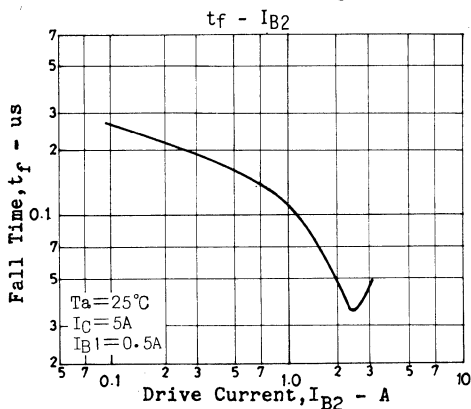
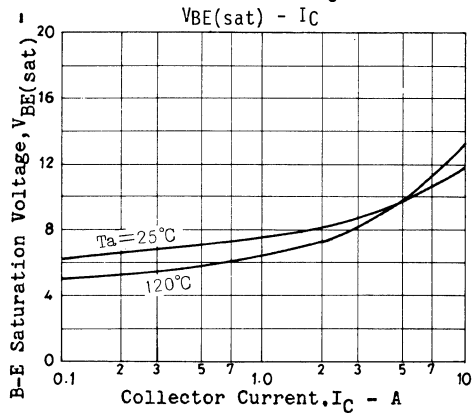
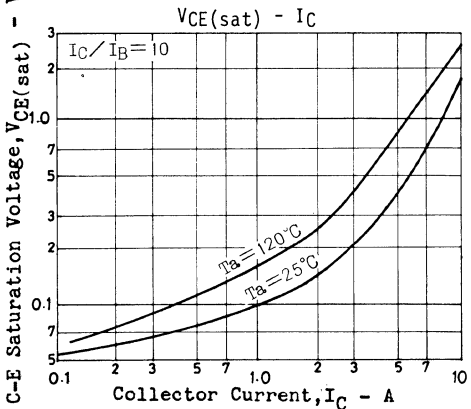
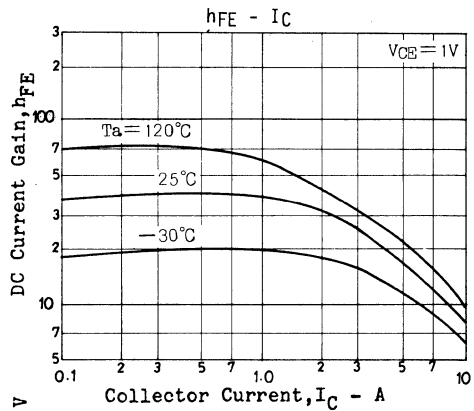
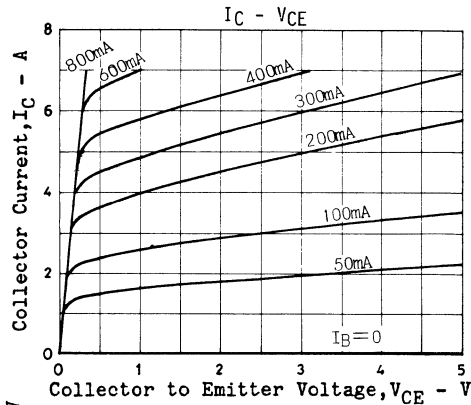
Specified Test Circuit



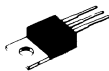
$V_{CC}=50\text{V}, I_C=5\text{A}$
 $I_{B1}=-I_{B2}=500\text{mA}$

Case Outline 2010A (unit:mm)





2SC3591



2010A

NPN Epitaxial Planar Silicon Transistor

High-Definition CRT Display Horizontal Deflection Output Applications

Ⓔ1609A

Features

- . Fast switching speed.
- . Low saturation voltage.
- . Adoption of MBIT proces.

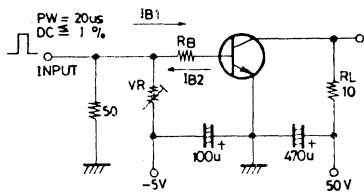
Absolute Maximum Ratings at Ta=25°C

Absolute Maximum Ratings at Ta=25°C			unit
Collector to Base Voltage	V _{CB0}	400	V
Collector to Emitter Voltage	V _{CEO}	200	V
Emitter to Base Voltage	V _{EB0}	6	V
Collector Current	I _C	7	A
Peak Collector Current	i _{cp}	12	A
Base Current	I _B	4	A
Collector Dissipation	P _C	50	W
Junction Temperature	T _j	150	°C
Storage Temperature	T _{stg}	-55 to +150	°C

Electrical Characteristics at Ta=25°C

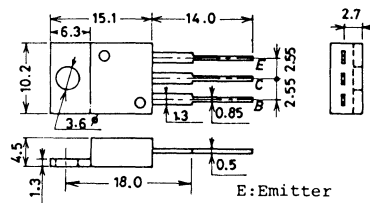
Electrical Characteristics at Ta=25°C			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=250V, I_E=0$			100	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			100	μA
DC Current Gain	$h_{FE(1)}$	$V_{CE}=1V, I_C=1A$	15			
	$h_{FE(2)}$	$V_{CE}=1V, I_C=5A$	10		50	
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.5A$	10	40		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=5A, I_B=0.5A$			0.8	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=5A, I_B=0.5A$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1mA, I_E=0$	400			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, R_{BE}=\infty$	200			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1mA, I_C=0$	6			V
Fall Time	t_f	At specified test circuit, $I_C=5A$, $I_{B1}=-I_{B2}=-0.5A$			0.3	μs

Switching Time Test Circuit

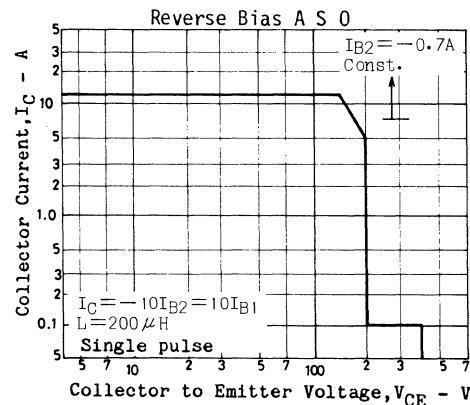
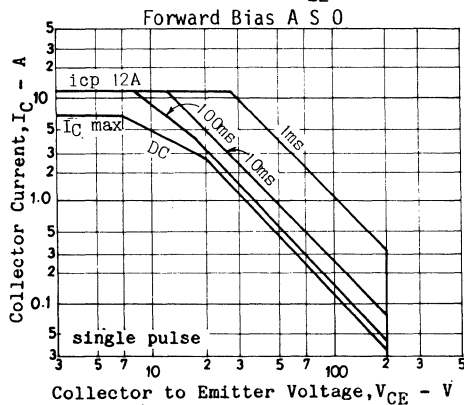
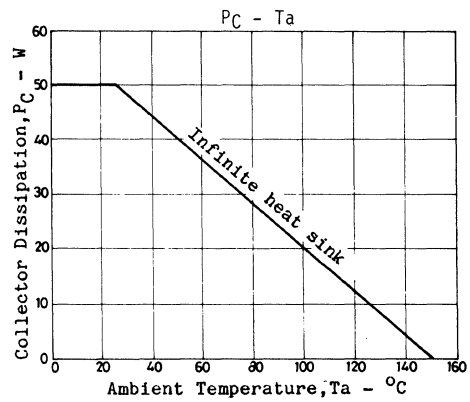
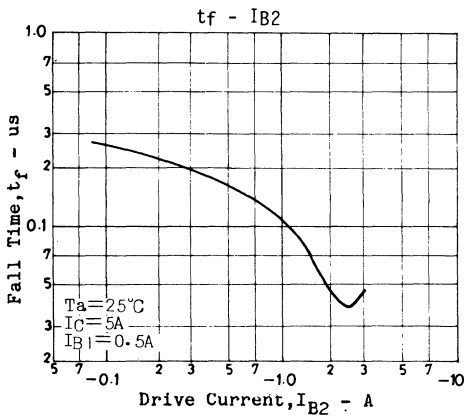
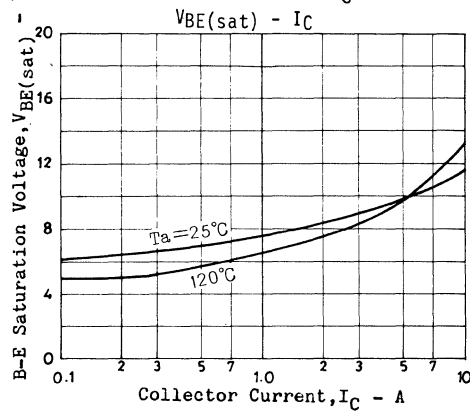
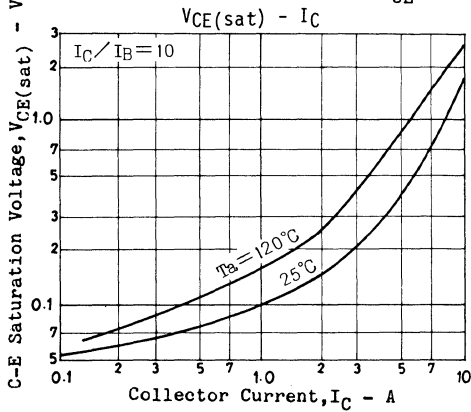
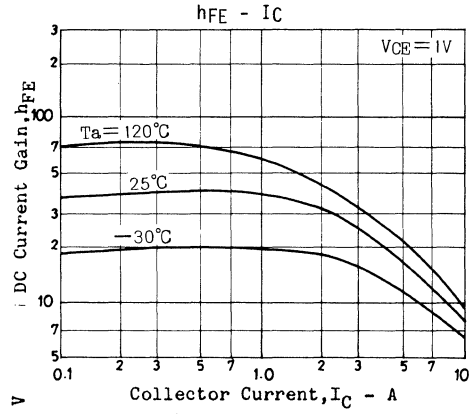
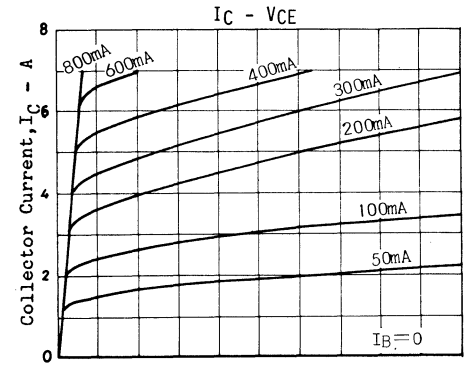

$$V_{CC}=50V, I_C=5A$$

$$I_{B1}=-I_{B2}=500mA$$
Case Outline 2010A

(unit:mm)



JEDEC: TO-220AB
EIAJ : SC-46



2SC3595



2009

NPN Epitaxial Planar
Silicon Transistor

Very High-Definition CRT Display Video Output Applications

(E)1756

Applications

- . Very high-definition CRT display.
- . Video output driver.
- . Wide-band amp.

Features

- . High f_T . f_T typ=2.0GHz.
- . High current. I_C =500mA

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	30	V
Collector to Emitter Voltage	V_{CE0}	20	V
Emitter to Base Voltage	V_{EB0}	3	V
Collector Current	I_C	500	mA
Peak Collector Current	i_{cp}	1000	mA
Collector Dissipation	P_C	1.2	W
		5	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

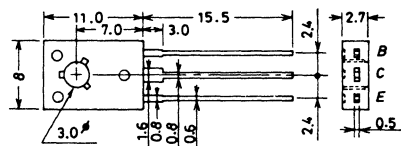
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=20\text{V}, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=2\text{V}$			5.0	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5\text{V}, I_C=50\text{mA}$	40		200	
	$h_{FE}(2)$	$V_{CE}=5\text{V}, I_C=500\text{mA}$	20			
Gain Bandwidth Product	f_T	$V_{CE}=5\text{V}, I_C=100\text{mA}$		2.0		GHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=300\text{mA}, I_B=30\text{mA}$	0.25	0.6		V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=300\text{mA}, I_B=30\text{mA}$	0.92	1.2		V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu\text{A}, I_E=0$	30			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1\text{mA}, R_{BE}=\infty$	20			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=100\mu\text{A}, I_C=\infty$	3			V
Output Capacitance	c_{ob}	$V_{CB}=10\text{V}, f=1\text{MHz}$		6.0		pF
Reverse Transfer Capacitance	c_{re}	$V_{CB}=10\text{V}, f=1\text{MHz}$		4.6		pF

* The 2SC3595 is classified by 50mA h_{FE} as follows:

40	C	80	60	D	120	100	E	200
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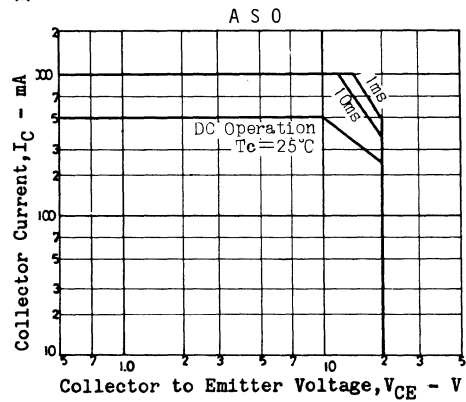
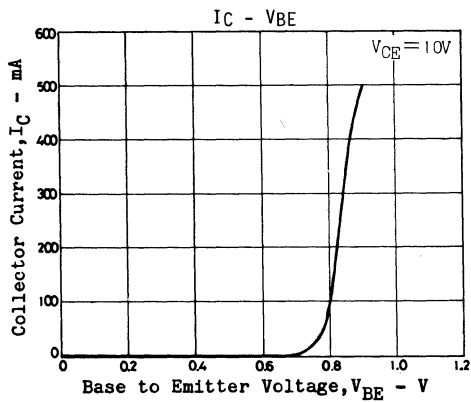
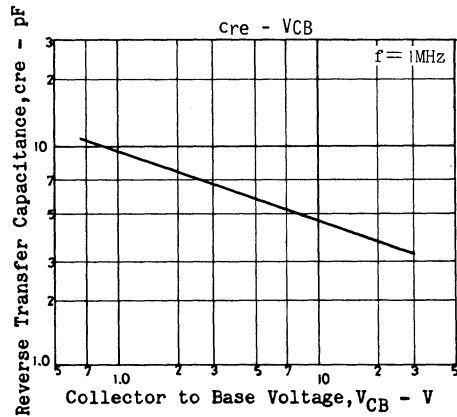
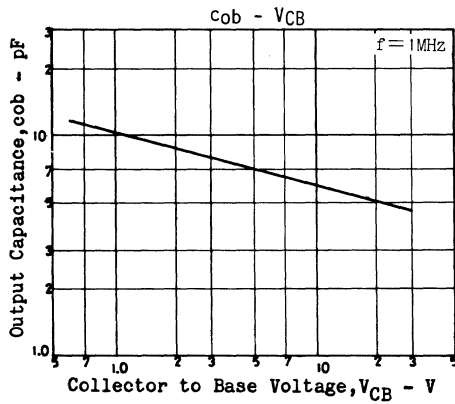
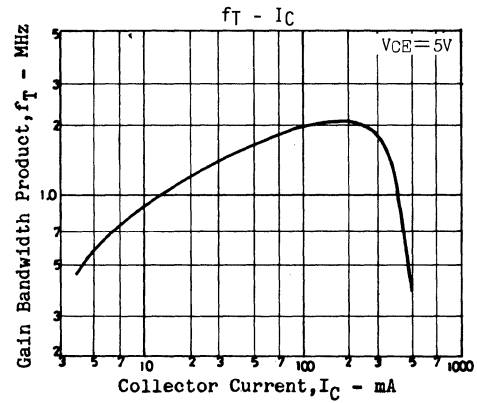
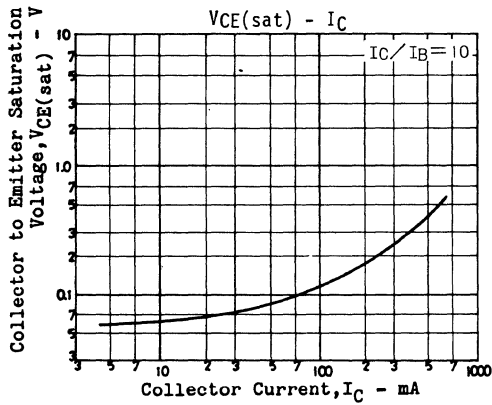
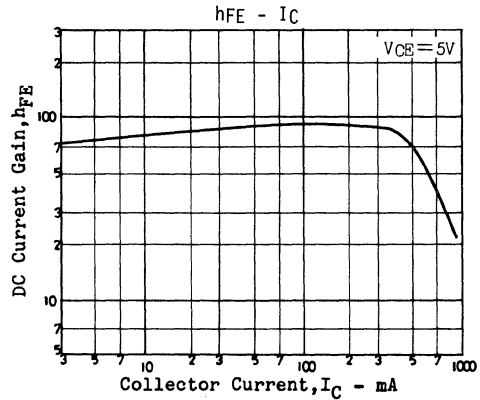
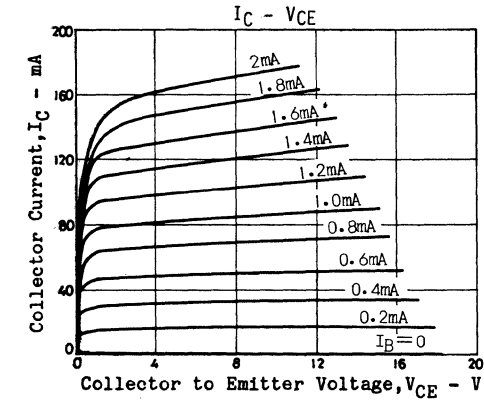
Case Outline 2009

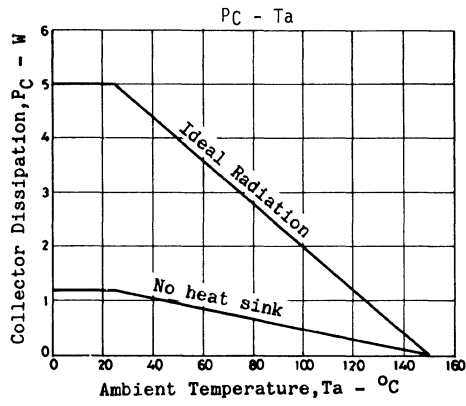
(unit:mm)



JEDEC : TO-126

B: Base
C: Collector
E: Emitter





2SC3596



2009

NPN/PNP Epitaxial Planar
Silicon Transistor

2SA1402

Very High-Definition CRT Display Video Output Applications

©1761

Applications

- . Very high-definition CRT display.
- . Video output.
- . Color TV chroma output.
- . Wide-band amp.

Features

- . High f_T . f_T typ=700MHz.
- . Small reverse transfer capacitance and excellent HF response
cre=1.8pF(NPN), 2.3pF(PNP).
- . Complementary PNP and NPN types.
- . Adoption of FBET process.

(): 2SA1402

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

Absolute Maximum Ratings at Ta=25°C				unit
Collector to Base Voltage	V _{CB0}	(-)80	V	
Collector to Emitter Voltage	V _{CE0}	(-)60	V	
Emitter to Base Voltage	V _{EB0}	(-)4	V	
Collector Current	I _C	(-)300	mA	
Peak Collector Current	i _{cp}	(-)600	mA	
Collector Dissipation	P _C	Ta=25°C Tc=25°C	1.2 8 W W	
Junction Temperature	T _j	150	°C	
Storage Temperature	T _{stg}	-55 to +150	°C	

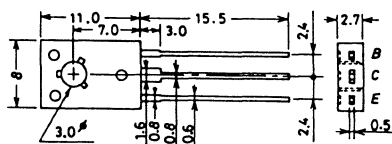
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)60\text{V}, I_E=0$			(-)0.1	uA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)2\text{V}, I_C=0$			(-)1.0	uA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$	40		320	
	$h_{FE}(2)$	$V_{CE}=(-)10\text{V}, I_C=(-)250\text{mA}$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)100\text{mA}$		700		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)100\text{mA}, I_B=(-)10\text{mA}$			0.6 (-0.8)	V V

* The 2SA1402/2SC3596 are classified by 50mA h_{FE} as follows:

40	C	80	60	D	120
100	E	200	160	F	320

Case Outline 2009
(unit:mm)

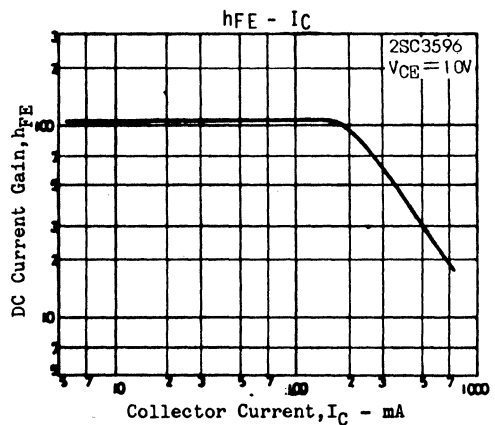
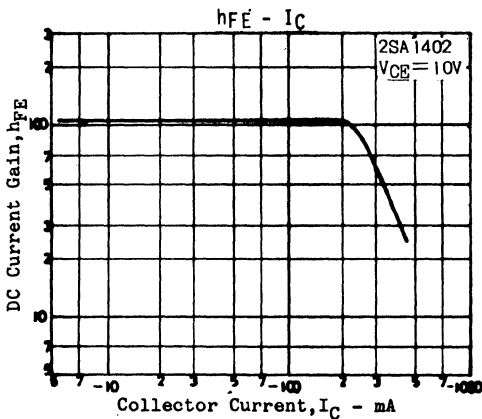
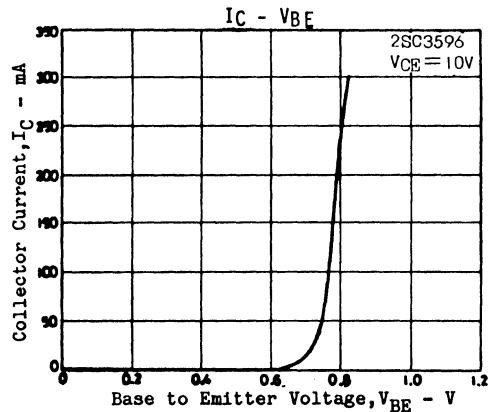
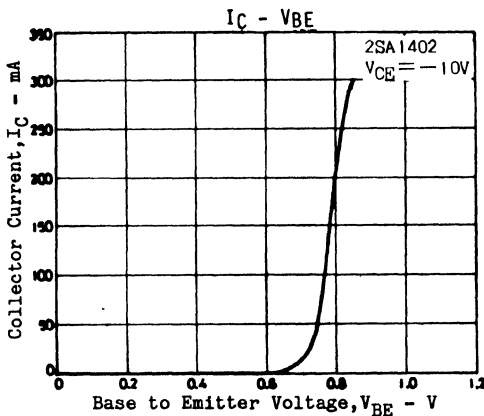
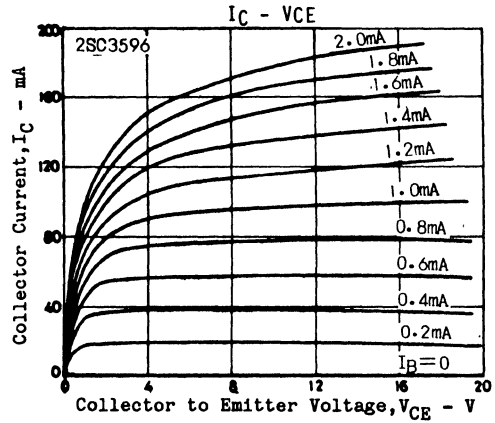
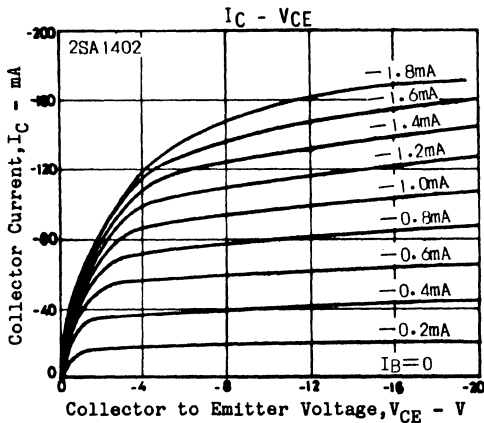


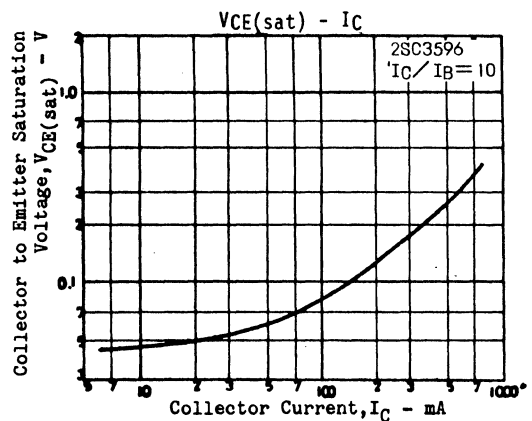
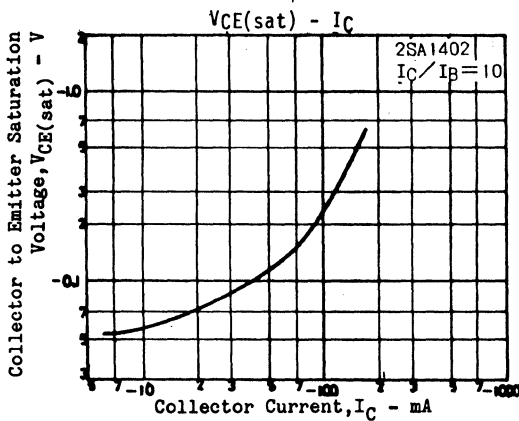
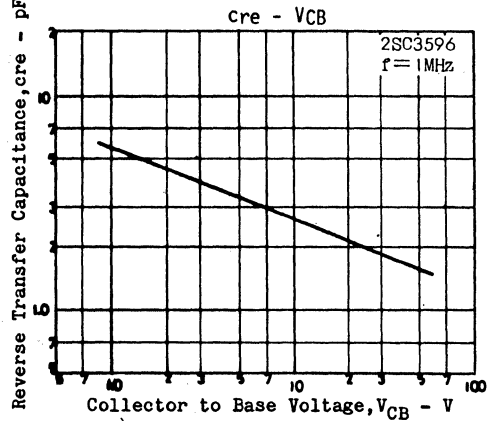
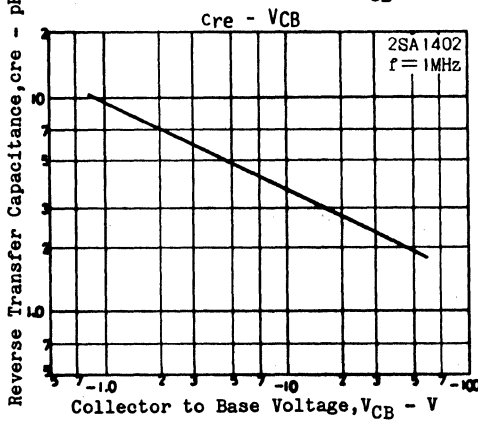
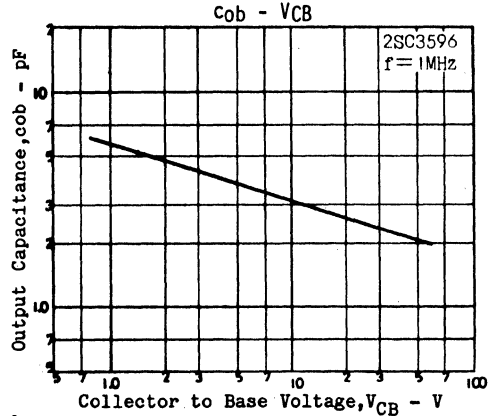
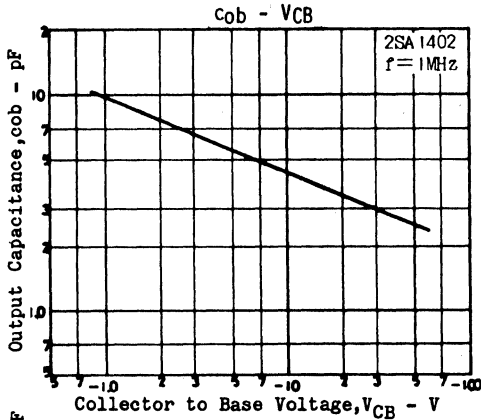
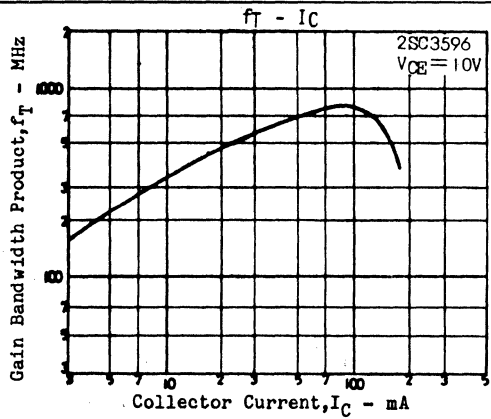
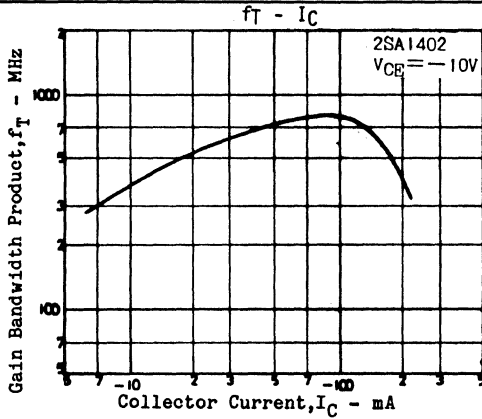
JEDEC: TO-126

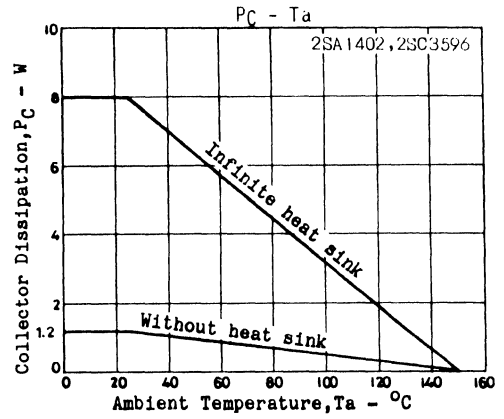
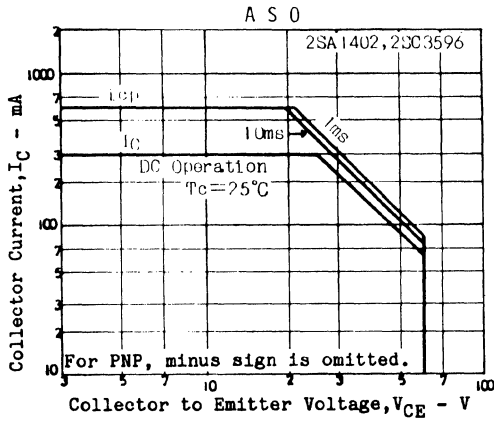
B: Base
C: Collector
E: Emitter

2225MY, TS No.1761-1/4

		min	typ	max	unit
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = (-)100mA, I_B = (-)10mA$		$(-)1.0$	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-)10\mu A, I_E = 0$		$(-)80$	V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$		$(-)60$	V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-)100\mu A, I_C = 0$		$(-)4$	V
Output Capacitance	c_{ob}	$V_{CB} = (-)30V, f = 1MHz$	2.3		pF
			(3.0)		pF
Reverse Transfer Capacitance c_{re}		$V_{CB} = (-)30V, f = 1MHz$	1.8		pF
			(2.3)		pF







2SC3597



2009

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1403

Very High-Definition CRT Display Video Output Applications

©1762

Applications

- . Very high-definition CRT display.
- . Video output.
- . Color TV chroma output.
- . Wide-band amp.

Features

- . High f_T . f_T typ=800MHz.
- . Small reverse transfer capacitance and excellent HF response
 c_{re} =2.9pF(NPN), 4.6pF(PNP).
- . Complementary PNP and NPN types.
- . Adoption of FBET process.

(): 2SA1403

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)80	V
Collector to Emitter Voltage	V_{CEO}	(-)60	V
Emitter to Base Voltage	V_{EBO}	(-)4	V
Collector Current	I_C	(-)500	mA
Peak Collector Current	i_{cp}	(-)1	A
Collector Dissipation	P_C	$T_a=25^\circ\text{C}$ 1.2 $T_c=25^\circ\text{C}$ 10	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

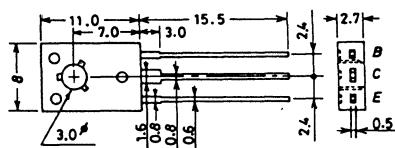
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)60\text{V}, I_E=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)2\text{V}, I_C=0$			(-)1.0	μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$	40		320	
	$h_{FE}(2)$	$V_{CE}=(-)10\text{V}, I_C=(-)400\text{mA}$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)100\text{mA}$		800		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)100\text{mA}, I_E=(-)10\text{mA}$			0.6 (-0.8)	V

* The 2SA1403/2SC3597 are classified by 50mA h_{FE} as follows:

40	C	80	60	D	120
100	E	200	160	F	320

Case Outline 2009
(unit:mm)

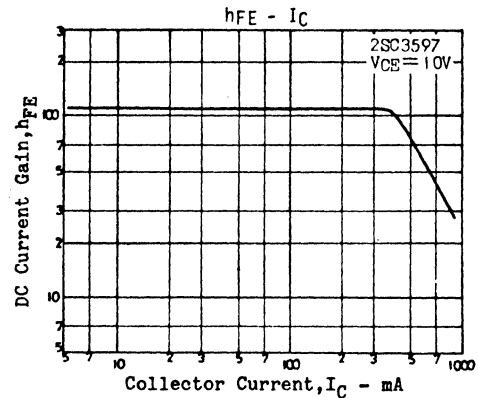
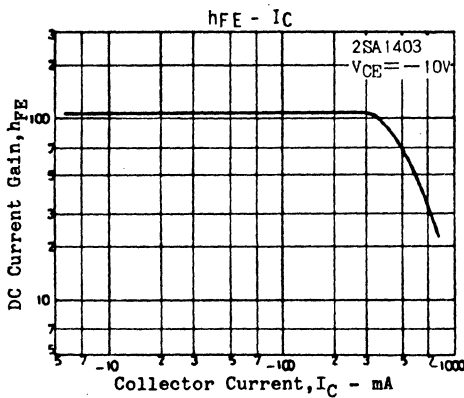
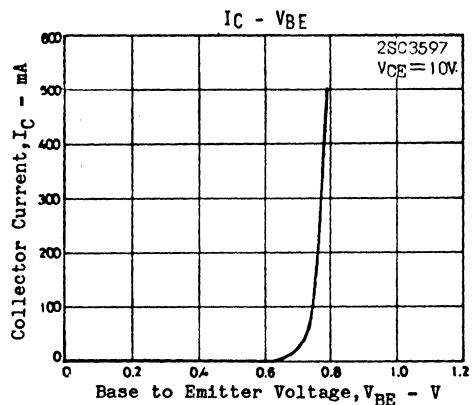
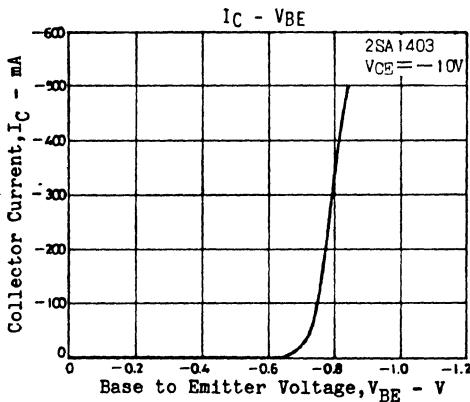
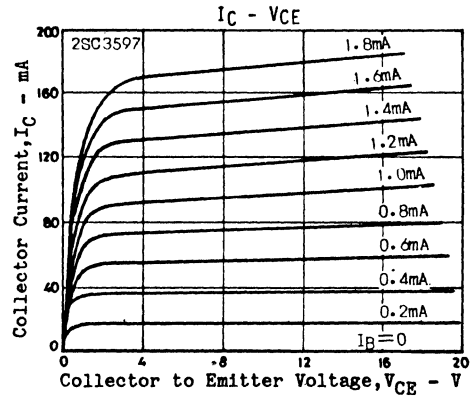
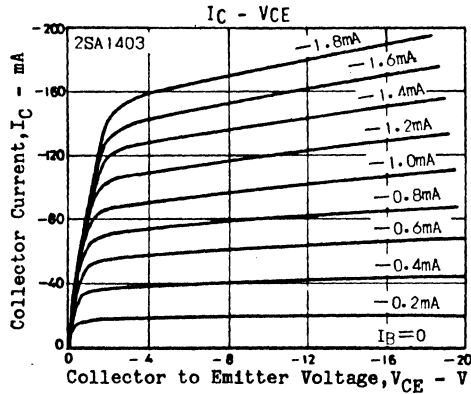


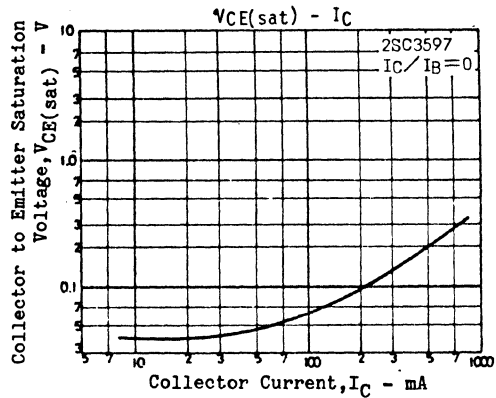
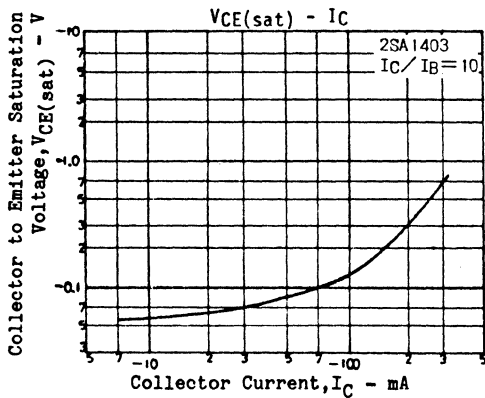
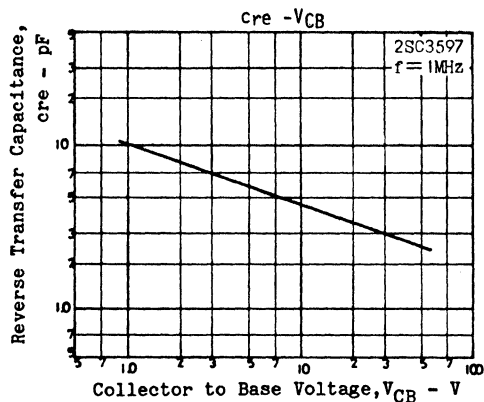
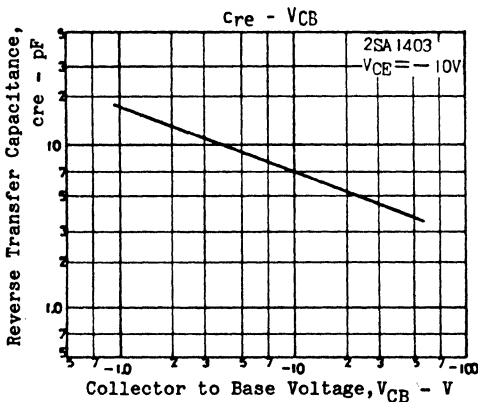
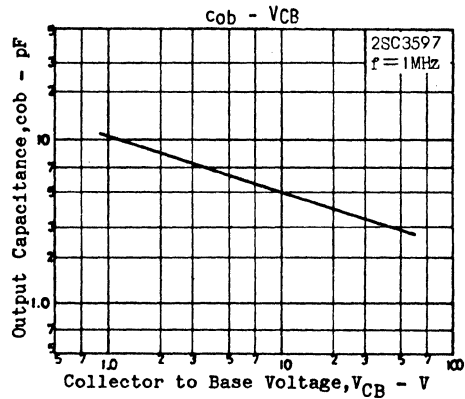
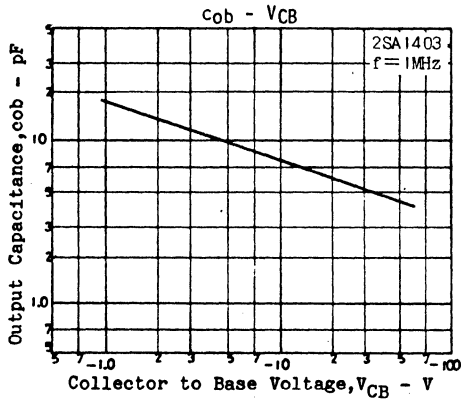
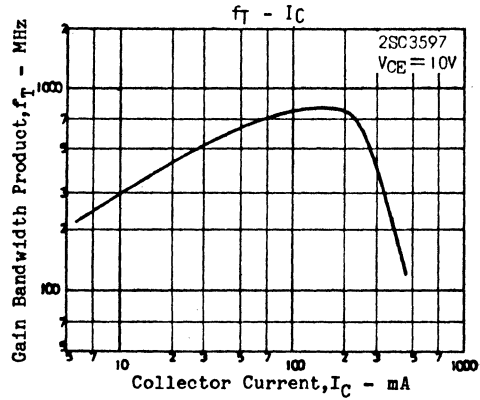
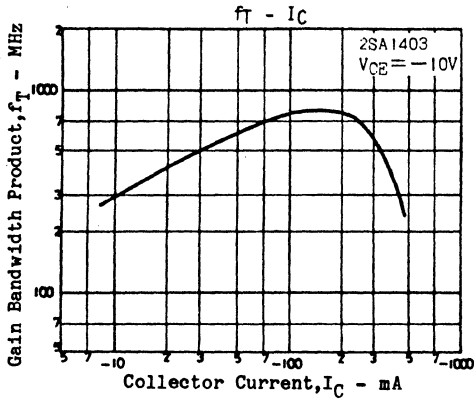
JEDEC: TO-126

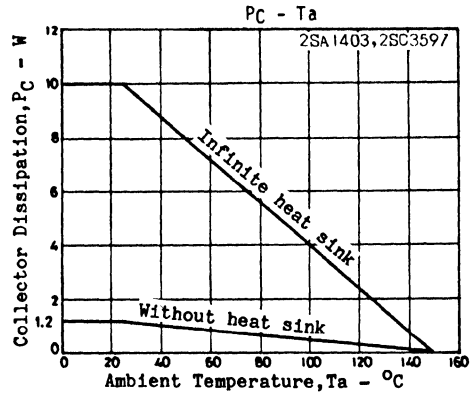
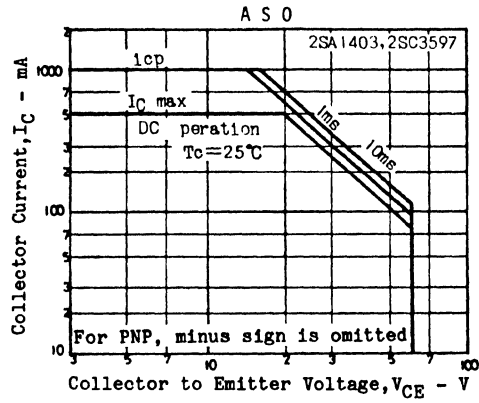
B: Base
C: Collector
E: Emitter

2225MY, TS No.1762-1/4

		min	typ	max	unit
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)100mA, I_B=(-)10mA$	(-)1.0		V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	(-)80		V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BF}=\infty$	(-)60		V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)100\mu A, I_C=0$	(-)4		V
Output Capacitance	c_{ob}	$V_{CB}=(-)30V, f=1MHz$	3.4		pF
			(5.2)		pF
Reverse Transfer Capacitance c_{re}		$V_{CB}=(-)30V, f=1MHz$	2.9		pF
			(4.6)		pF







2SC3598



2009

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1404

Very High-Definition CRT Display Video Output Applications

©1763

Applications

- . Very high-definition CRT display.
- . Video output.
- . Color TV chroma output.
- . Wide-band amp.

Features

- . High f_T . f_T typ=500MHz.
- . High breakdown voltage. $V_{CEO} \geq 120V$
- . Small reverse transfer capacitance and excellent HF response
cre=1.6pF(NPN), 2.1pF(PNP).
- . Complementary PNP and NPN types.
- . Adoption of FBET process.

(): 2SA1404

Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	(-)120	V
Collector to Emitter Voltage	V_{CEO}	(-)120	V
Emitter to Base Voltage	V_{EBO}	(-)4	V
Collector Current	I_C	(-)200	mA
Peak Collector Current	i_{cp}	(-)400	mA
Collector Dissipation	P_C	$T_a=25^\circ C$	1.2 W
		$T_c=25^\circ C$	8 W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

Electrical Characteristics at $T_a=25^\circ C$

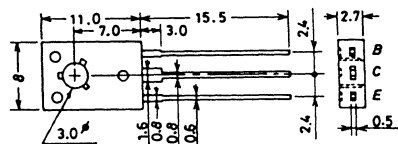
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80V, I_E=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)2V, I_C=0$			(-)1.0	μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)10V, I_C=(-)10mA$	40		320	
	$h_{FE}(2)$	$V_{CE}=(-)10V, I_C=(-)150mA$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		500		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)50mA, I_B=(-)5mA$			0.6	V
					(-0.8)	V

* The 2SA1404/2SC3598 are classified by 10mA h_{FE} as follows:

40	C	80	60	D	120
100	E	200	160	F	320

Case Outline 2009

(unit:mm)

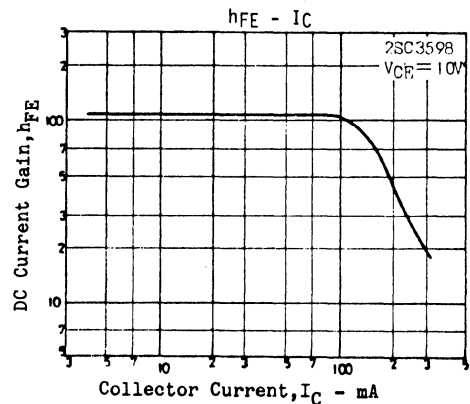
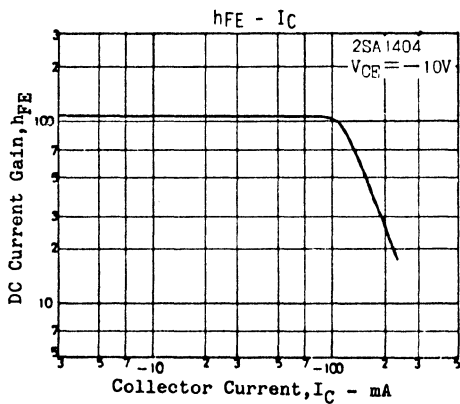
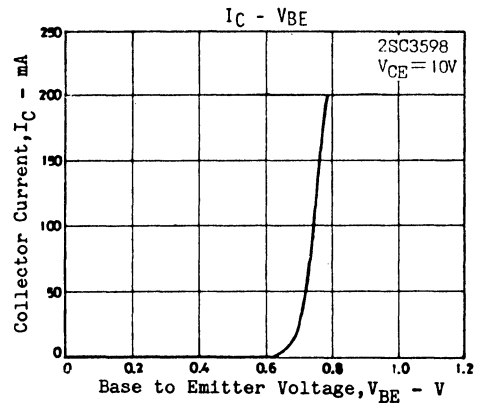
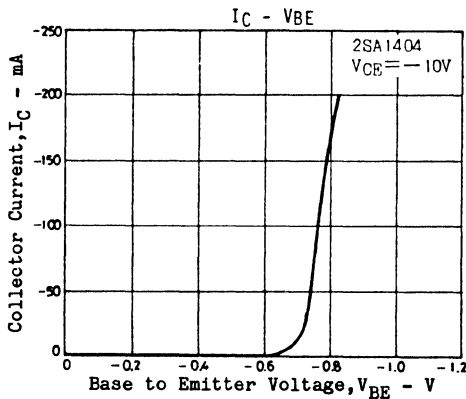
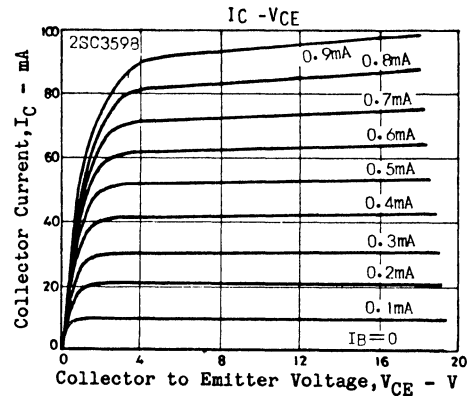
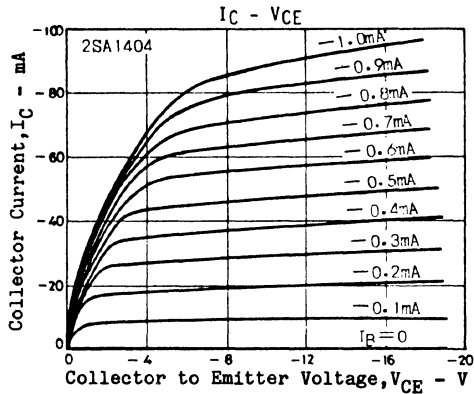


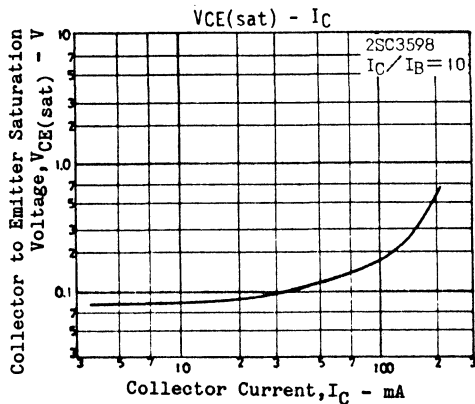
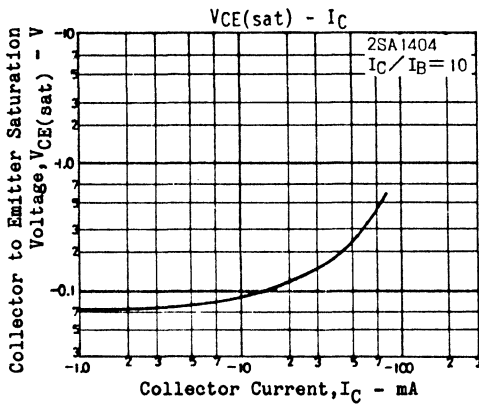
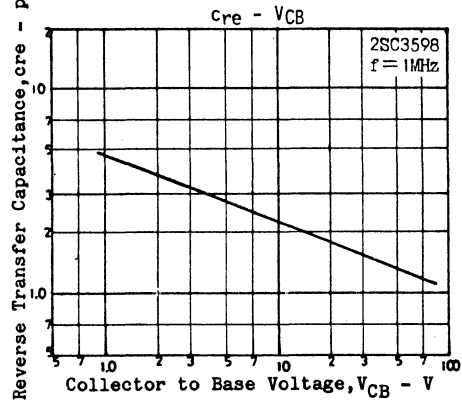
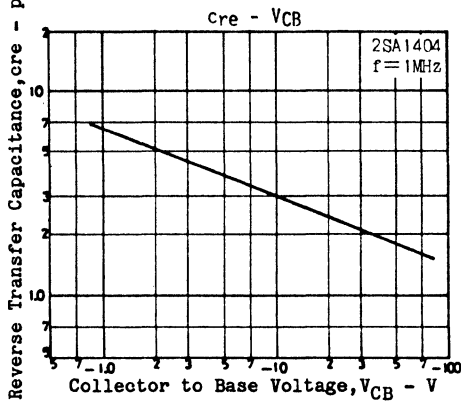
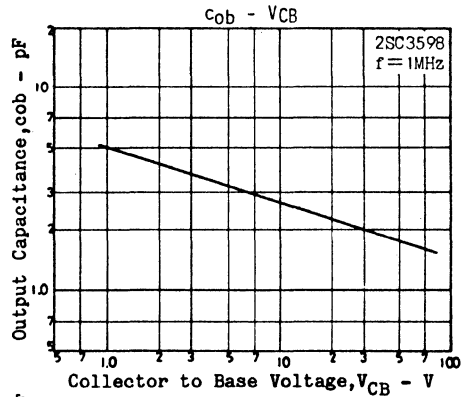
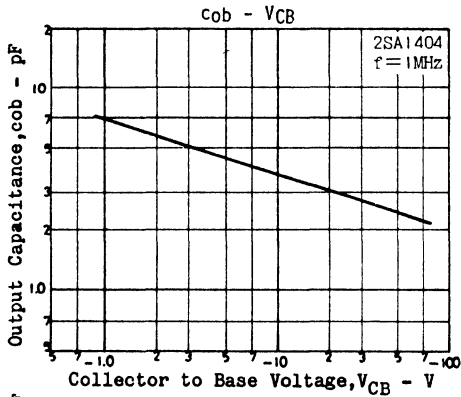
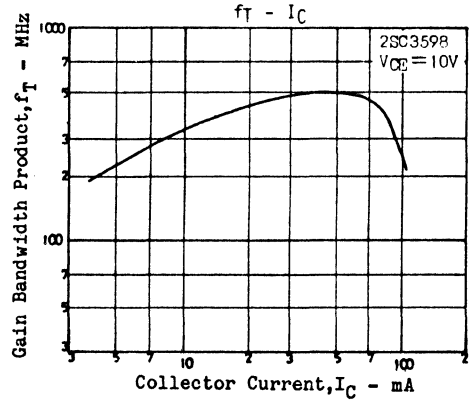
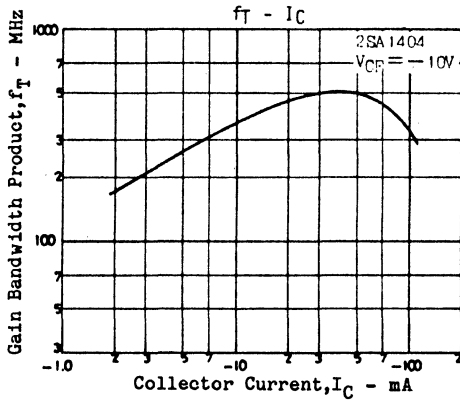
JEDEC: TO-126

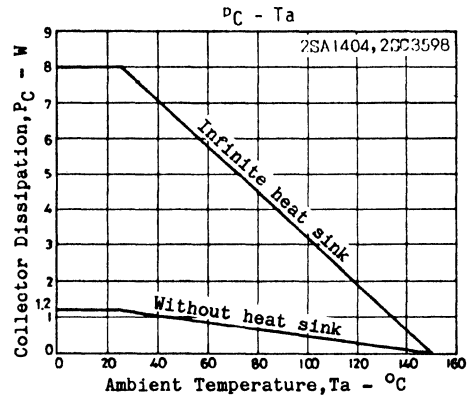
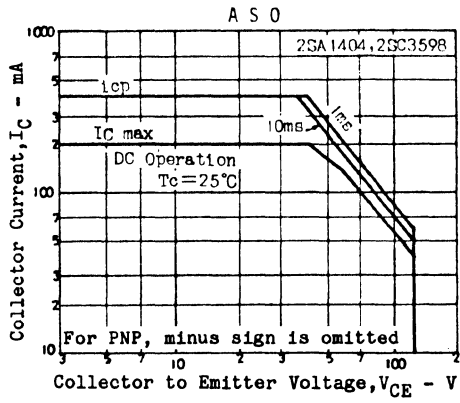
B: Base
C: Collector
E: Emitter

2225MY, TS No.1763-1/4

		min	typ	max	unit
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)50mA, I_B=(-)5mA$		(-) 1.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	(-) 120		V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	(-) 120		V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)100\mu A, I_C=0$	(-) 4		V
Output Capacitance	C_{ob}	$V_{CB}=(-)30V, f=1MHz$	2.0		pF
			(2.7)		pF
Reverse Transfer Capacitance c_{re}		$V_{CB}=(-)30V, f=1MHz$	1.6		pF
			(2.1)		pF







2SC3599



2009

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1405

Very High-Definition CRT Display Video Output Applications

©1764

Applications

- . Very high-definition CRT display.
- . Video output.
- . Color TV chroma output.
- . Wide-band amp.

Features

- . High f_T . f_T typ=500MHz.
- . High breakdown voltage. $V_{CEO} \geq 120V$
- . Small reverse transfer capacitance and excellent HF response
cre=2.5pF(NPN), 3.8pF(PNP).
- . Complementary PNP and NPN type.
- . Adoption of FBET process.

(): 2SA1405

Absolute Maximum Ratings at $T_a=25^\circ C$

Absolute Maximum Ratings at Ta=25°C				unit
Collector to Base Voltage	V _{CB0}	(-)120	V	
Collector to Emitter Voltage	V _{CEO}	(-)120	V	
Emitter to Base Voltage	V _{EBO}	(-)4	V	
Collector Current	I _C	(-)300	mA	
Peak Collector Current	i _{cp}	(-)600	mA	
Collector Dissipation	P _C	Ta=25°C	1.2	W
		Tc=25°C	8	W
Junction Temperature	T _j		150	°C
Storage Temperature	T _{stg}		-55 to +150	°C

Electrical Characteristics at $T_a=25^\circ C$

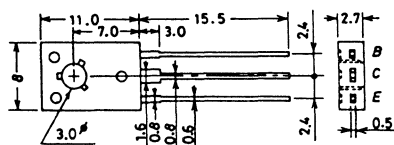
			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)80V, I_E=0$			(-)0.1	uA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)2V, I_C=0$			(-)1.0	uA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)10V, I_C=(-)50mA$	40		320	
	$h_{FE}(2)$	$V_{CE}=(-)10V, I_C=(-)250mA$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		500		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)70mA, I_B=(-)7mA$			0.6 (-0.8)	V V

* The 2SA1405/2SC3599 are classified by 50mA h_{FE} as follows:

40	C	80	60	D	120
100	E	200	160	F	320

Case Outline 2009

(unit:mm)

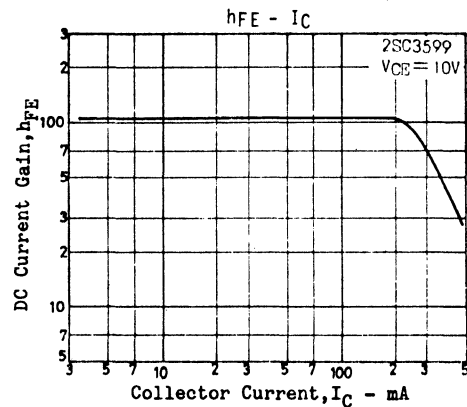
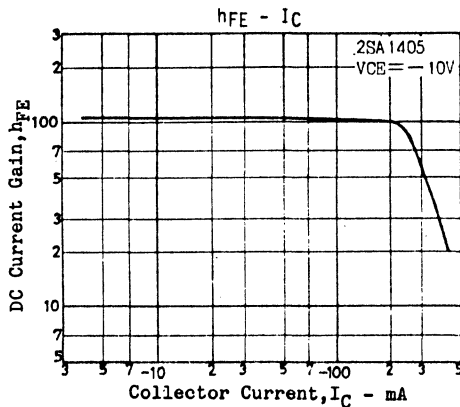
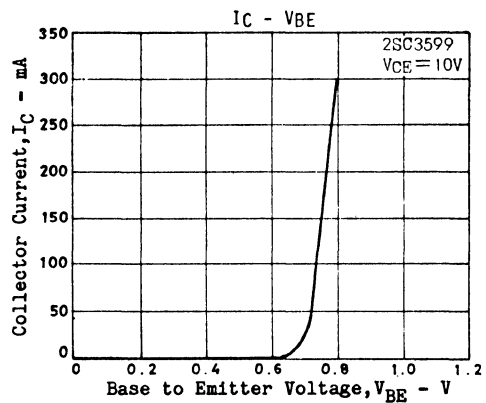
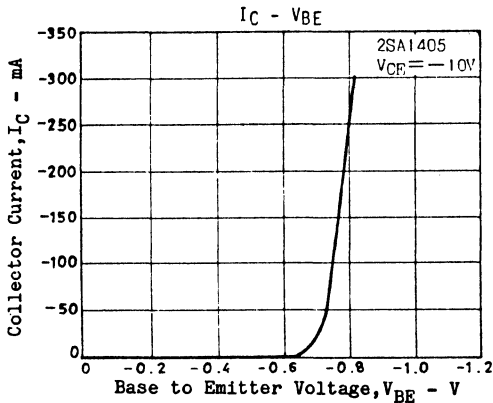
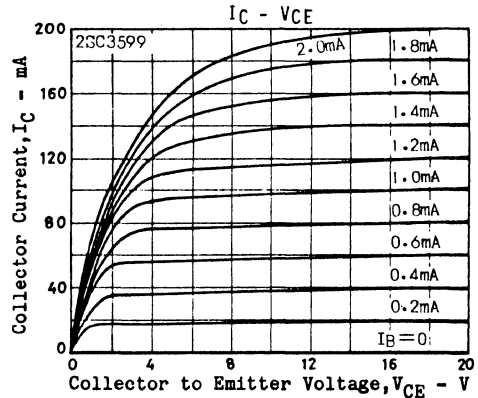
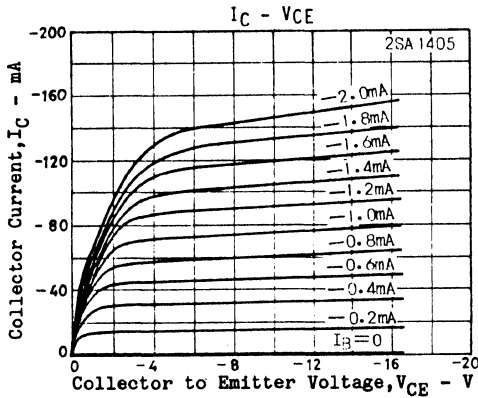


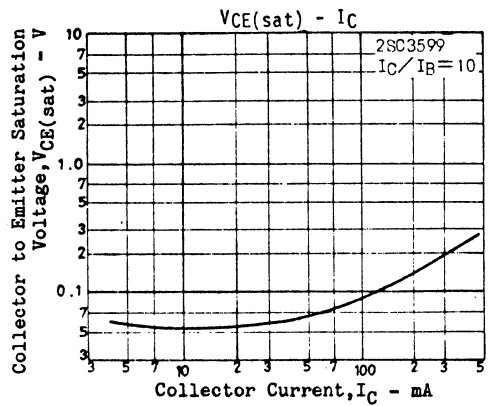
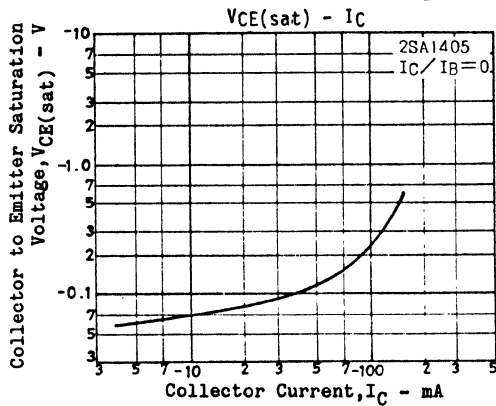
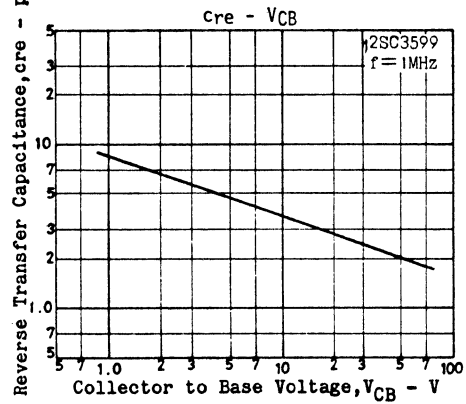
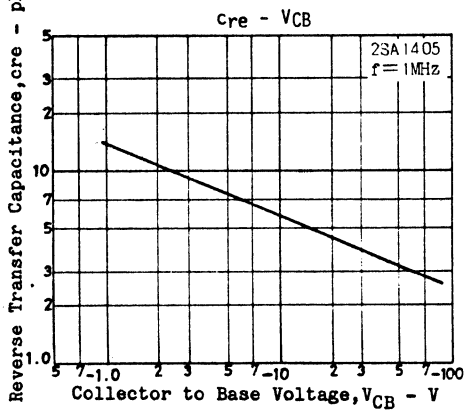
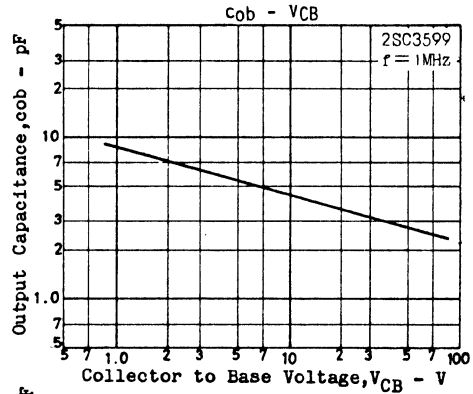
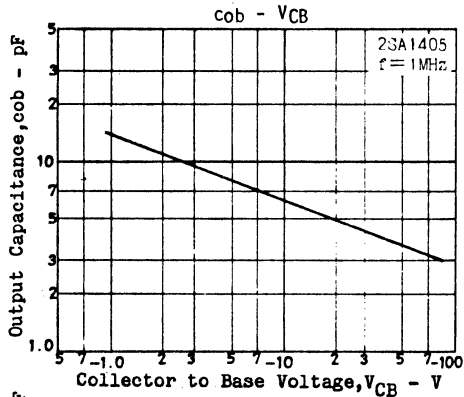
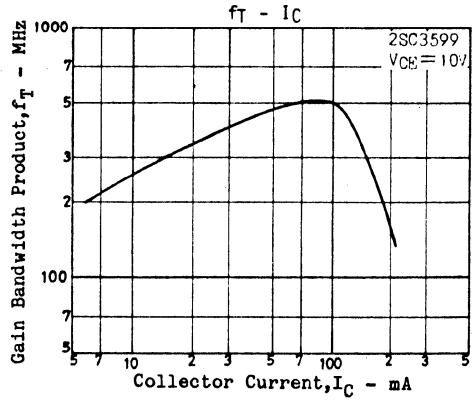
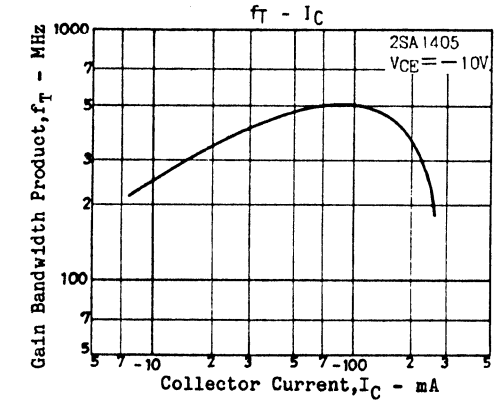
JEDEC: TO-126

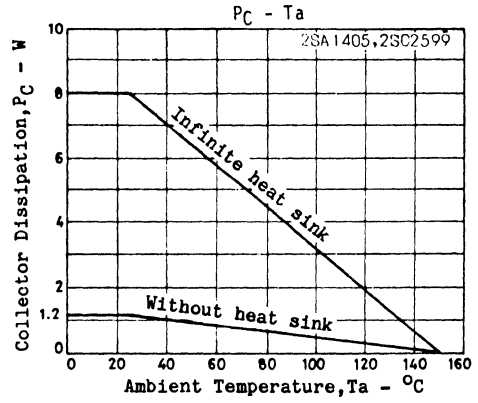
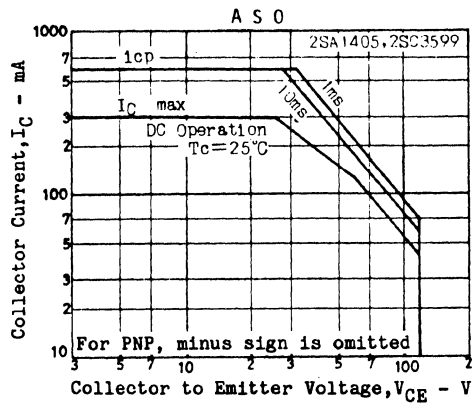
B: Base
C: Collector
E: Emitter

2225MY, TS No.1764-1/4

			min	typ	max	unit
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)70mA, I_B=(-)7mA$			(-)1.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$			(-)120	V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$			(-)120	V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)100\mu A, I_C=0$			(-)4	V
Output Capacitance	c_{ob}	$V_{CB}=(-)30V, f=1MHz$		2.9 (4.3)		pF
Reverse Transfer Capacitance c_{re}		$V_{CB}=(-)30V, f=1MHz$		2.5 (3.8)		pF







2SC3600



2009

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1406

Very High-Definition CRT Display Video Output Applications

©1765

Applications

- . Very high-definition CRT display.
- . Video output.
- . Color TV chroma output.
- . Wide-band amp.

Features

- . High f_T . f_T typ=400MHz.
- . High breakdown voltage. $V_{CEO} \geq 200V$
- . Small reverse transfer capacitance and excellent HF response
 $c_{re}=1.4pF$ (NPN), $1.7pF$ (PNP).
- . Complementary PNP and NPN types.
- . Adoption of FBET process.

(): 2SA1406

Absolute Maximum Ratings at $T_a=25^\circ C$

Absolute Maximum Ratings at Ta=25°C				unit
Collector to Base Voltage	V _{CBO}	(-)200	V	
Collector to Emitter Voltage	V _{CEO}	(-)200	V	
Emitter to Base Voltage	V _{EBO}	(-)4	V	
Collector Current	I _C	(-)100	mA	
Peak Collector Current	i _{cp}	(-)200	mA	
Collector Dissipation	P _C	Ta=25°C	1.2	W
		Tc=25°C	7	W
Junction Temperature	T _j		150	°C
Storage Temperature	T _{stg}		-55 to +150	°C

Electrical Characteristics at $T_a=25^\circ C$

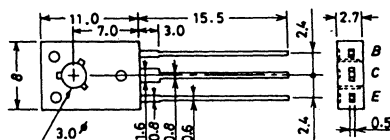
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)150V, I_E=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)2V, I_C=0$			(-)1.0	μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)10V, I_C=(-)10mA$	40		320	
	$h_{FE}(2)$	$V_{CE}=(-)10V, I_C=(-)60mA$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)30V, I_C=(-)30mA$		400		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)30mA, I_E=(-)3mA$			0.6 (-0.8)	V

* The 2SA1406/2SC3600 are classified by 10mA h_{FE} as follows:

40	C	80	60	D	120
100	E	200	160	F	320

Case Outline 2009

(unit:mm)

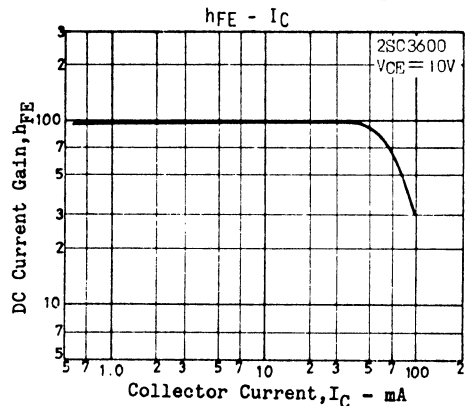
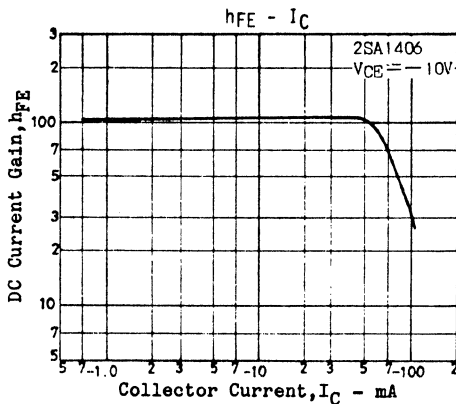
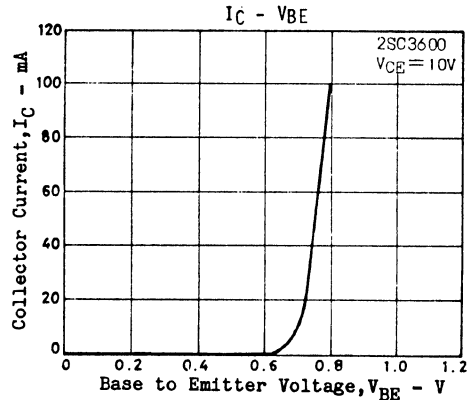
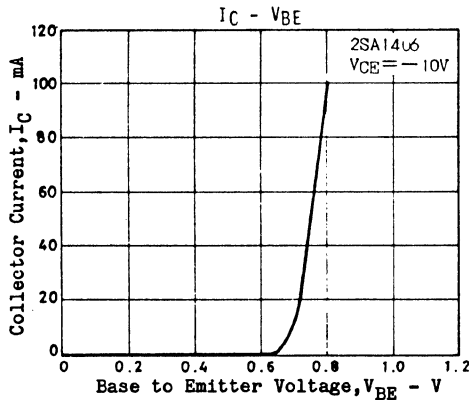
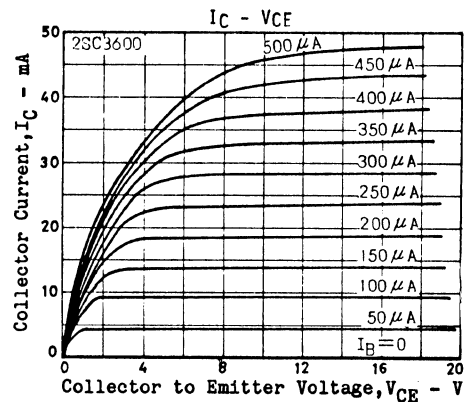
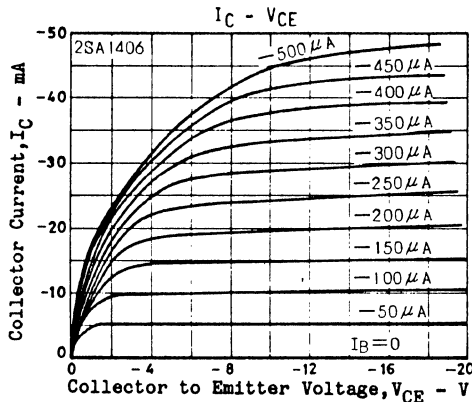


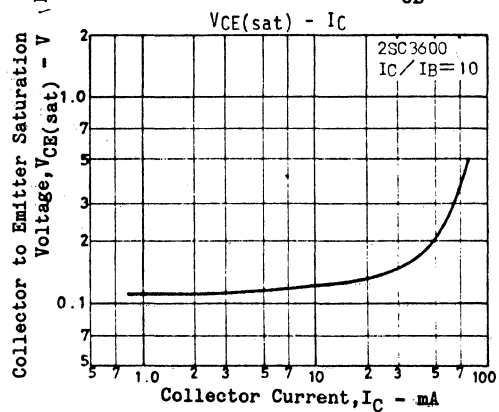
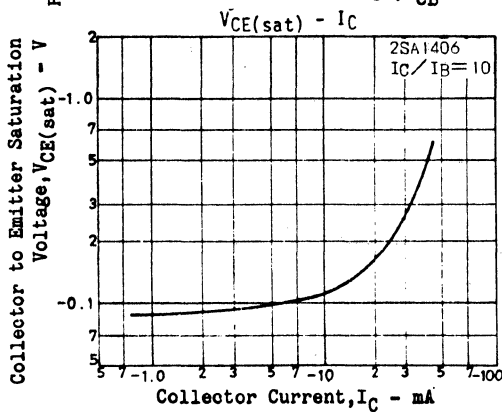
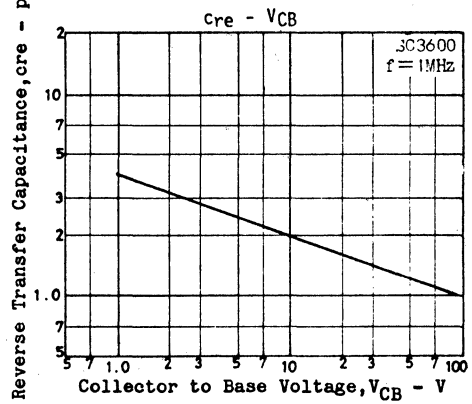
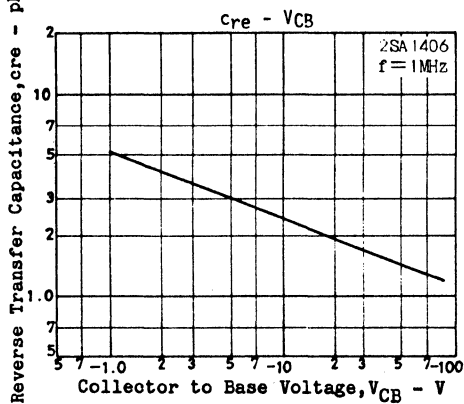
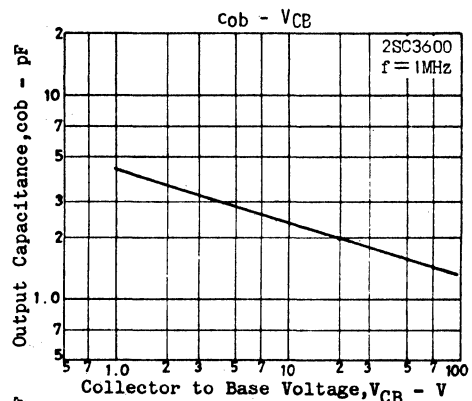
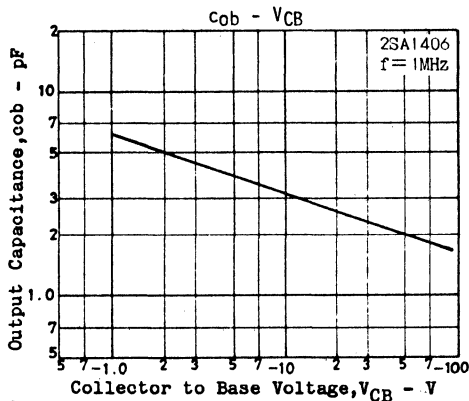
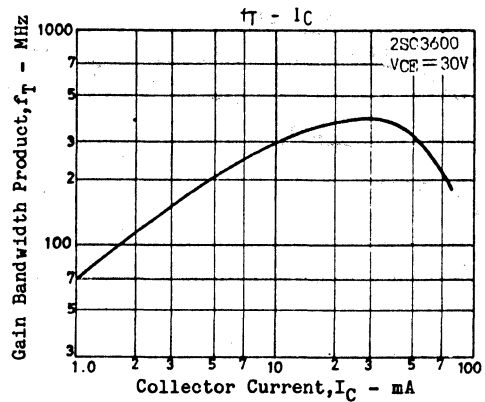
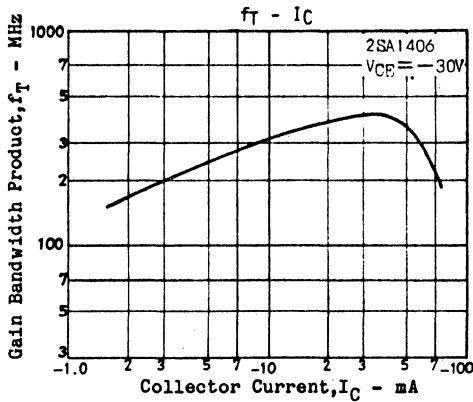
JEDEC: TO-126

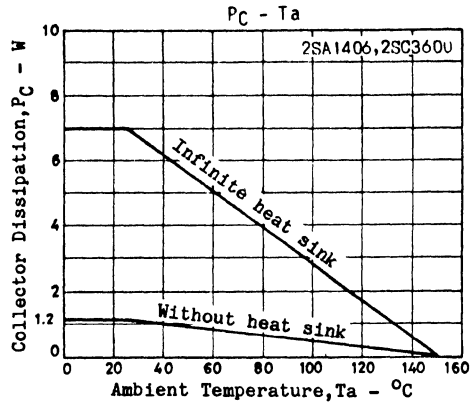
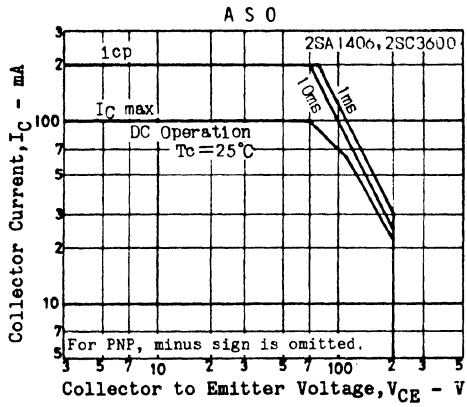
B: Base
C: Collector
E: Emitter

2225MY, TS No.1765-1/4

		min	typ	max	unit
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)30mA, I_B=(-)3mA$		$(-)1.0$	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$		$(-)200$	V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$		$(-)200$	V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)100\mu A, I_C=0$		$(-)4$	V
Output Capacitance	c_{ob}	$V_{CB}=(-)30V, f=1MHz$	1.8 (2.3)		pF
Reverse Transfer Capacitance	c_{re}	$V_{CB}=(-)30V, f=1MHz$	1.4 (1.7)		pF







2009

NPN/PNP Epitaxial Planar Silicon Transistors

Very High-Definition CRT Display Video Output Applications

(E)1766

Applications

- . Very high-definition CRT display.
- . Video output.
- . Color TV chroma output.
- . Wide-band amp.

Features

- . High f_T . f_T typ=400MHz.
- . High breakdown voltage. $V_{CEO} \geq 200V$
- . Small reverse transfer capacitance and excellent HF response
cre=2.0pF(NPN), 2.5pF(PNP).
- . Complementary PNP and NPN types.
- . Adoption of FBET process.

(): 2SA1407

Absolute Maximum Ratings at Ta=25°C

Absolute Maximum Ratings at Ta=25°C			unit
Collector to Base Voltage	V _{CBO}	(-)200	V
Collector to Emitter Voltage	V _{CEO}	(-)200	V
Emitter to Base Voltage	V _{EB0}	(-)4	V
Collector Current	I _C	(-)150	mA
Peak Collector Current	i _{cp}	(-)300	mA
Collector Dissipation	P _C	Ta=25°C 1.2	W
		Tc=25°C 7	W
Junction Temperature	T _j	150	°C
Storage Temperature	T _{stg}	-55 to +150	°C

Electrical Characteristics at Ta=25°C

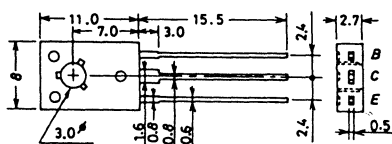
Electrical Characteristics at Ta=25°C			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)150V, I_E=0$			(-) 0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)2V, I_C=0$			(-) 1.0	μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)10V, I_C=(-)10mA$	40		320	
	$h_{FE}(2)$	$V_{CE}=(-)10V, I_C=(-)100mA$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)30V, I_C=(-)50mA$		400		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)50mA, I_B=(-)5mA$			0.6 (-) 0.8	V V

* The 2SA1407/2SC3601 are classified by 10mA h_{FE} as follows:

40	C	80	60	D	120
100	E	200	160	F	320

Case Outline 2009

(unit:mm)



JEDEC: TO-126

B: Base
C: Collector
E: Emitter

2SC3601/2SA1407

			min	typ	max	unit
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)50mA, I_B=(-)5mA$			(-) 1.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$		(-) 200		V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$		(-) 200		V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)100\mu A, I_C=0$		(-) 4		V
Output Capacitance	c_{ob}	$V_{CB}=(-)30V, f=1MHz$		2.5 (3.0)		pF
Reverse Transfer Capacitance	c_{re}	$V_{CB}=(-)30V, f=1MHz$		2.0 (2.5)		pF



2022

Very High-Definition CRT Display Horizontal Deflection Output Applications

©1614A

- . High reliability (Adoption of HVP process)
- . Fast speed.
- . High breakdown voltage.
- . Adoption of MBIT process.

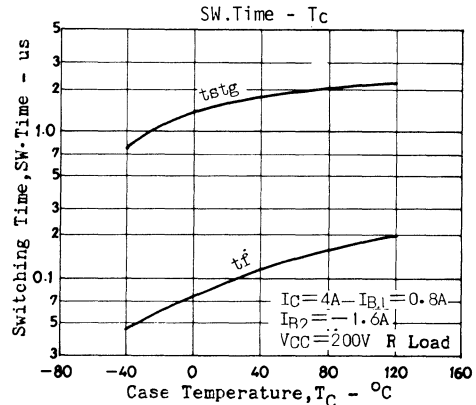
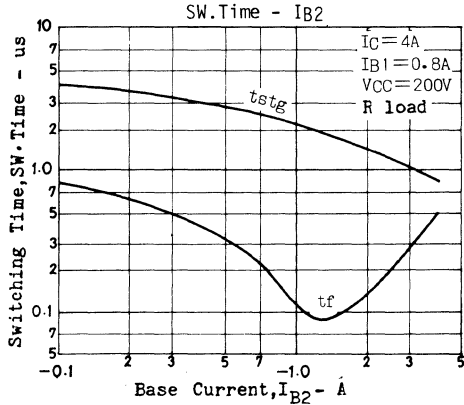
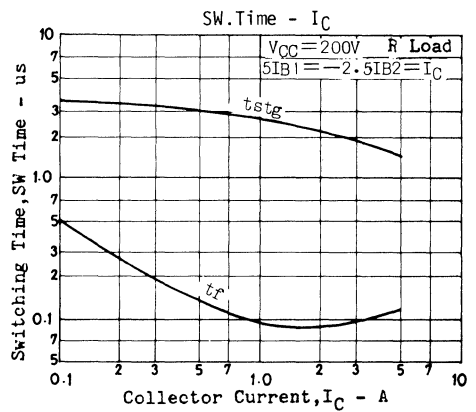
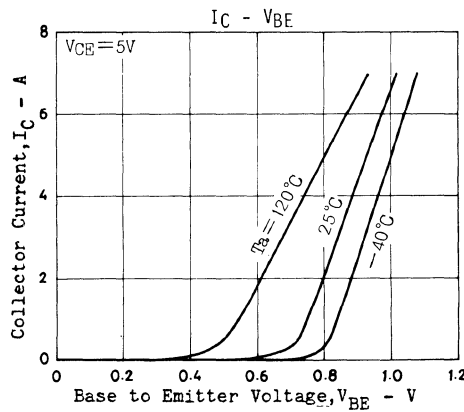
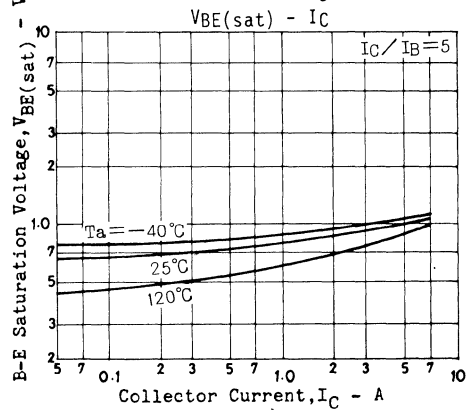
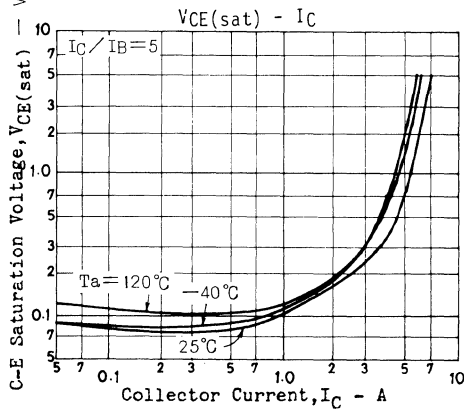
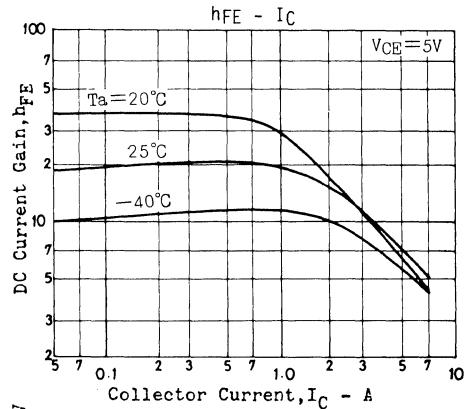
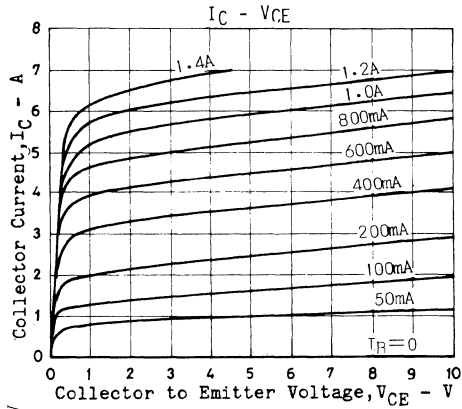
Collector to Base Voltage	V_{CBO}	900	V
Collector to Emitter Voltage	V_{CEO}	500	V
Emitter to Base Voltage	V_{EB0}	7	V
Collector Current	I_C	7	A
Peak Collector Current	i_{cp}	14	A
Collector Dissipation	P_C	80	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

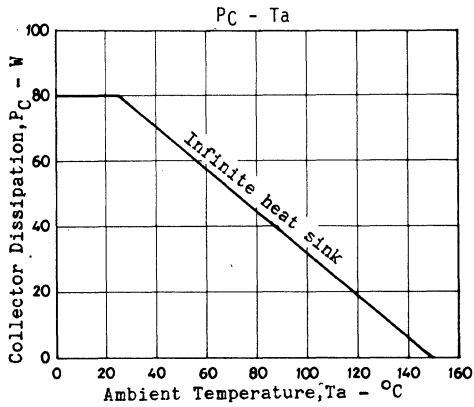
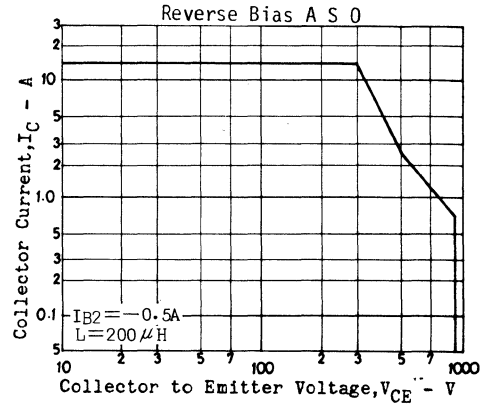
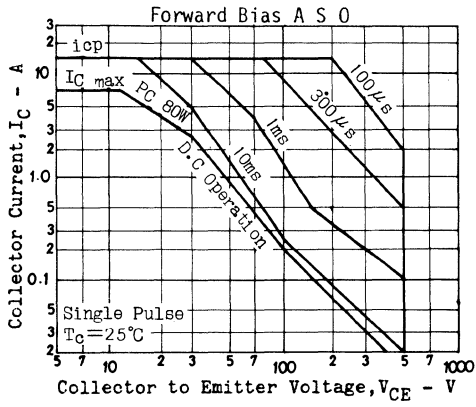
Collector Cutoff Current	I_{CBO}	$V_{CB}=500V, I_E=0$	10	μA
	I_{CES}	$V_{CE}=900V, R_{BE}=0$	0.5	mA
Collector to Emitter Sustain Voltage	$V_{CEO(sus)}$	$I_C=100mA, I_B=0$	500	V
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$	1	mA
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=4A, I_B=0.8A$	2	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=4A, I_B=0.8A$	1.5	V
DC Current Gain	f_{FE}	$V_{CE}=5V, I_C=0.8A$	8	
Storage Time	t_{stg}	$I_C=4A, I_{B1}=0.8A, I_{B2}=-1.6A$	3.0	μs
Fall Time	t_f	$I_C=4A, I_{B1}=0.8A, I_{B2}=-1.6A$	0.1	0.2 μs

Figure 1: Dimensions of the TO3P package. The diagram shows a side view and a top view of the package. The side view includes dimensions: 20.0 (total length), 15.6 (height), 14.0 (height), 3.2 (hole diameter), 1.0 (lead length), 2.0 (lead length), 1.6 (lead length), 15.0 (base length), and 20.0 (total length). The top view includes dimensions: 4.8 (width), 2.0 (width), and 0.6 (width). A legend on the right identifies the components: E: Emit, C: Coll, B: Base. The text 'SANYO TO3P' is at the bottom right.

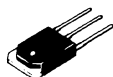
E: Emitter
C: Collector
B: Base

SANYO : T03PB





2SC3637



2022

NPN Triple Diffused Planar
Silicon Transistor

Very High-Definition CRT Display Horizontal Deflection Output Applications

©1615A

Features

- . High reliability (Adoption of HVP process)
- . Fast speed.
- . High breakdown voltage.
- . Adoption of MBIT process.

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

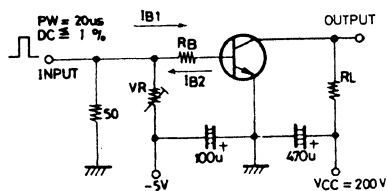
			unit
Collector to Base Voltage	V_{CB0}	900	V
Collector to Emitter Voltage	V_{CE0}	500	V
Emitter to Base Voltage	V_{EB0}	7	V
Collector Current	I_C	10	A
Peak Collector Current	i_{cp}	20	A
Collector Dissipation	P_C	90	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

$T_c=25^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

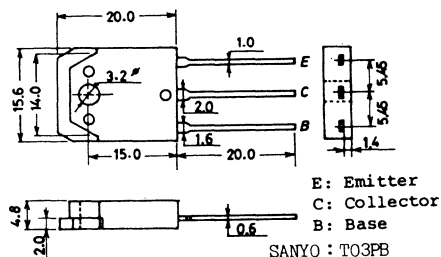
			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=500\text{V}, I_E=0$			10	μA
	I_{CES}	$V_{CE}=900\text{V}, R_{BE}=0$			0.5	mA
Collector to Emitter Sustain Voltage	$V_{CE0}(\text{sus})$	$I_C=100\text{mA}, I_B=0$	500			V
Emitter Cutoff Current	I_{EB0}	$V_{EB}=5\text{V}, I_C=0$			1	mA
Collector to Emitter Saturation Voltage	$V_{CE}(\text{sat})$	$I_C=5\text{V}, I_B=1\text{A}$			2	V
Base to Emitter Saturation Voltage	$V_{BE}(\text{sat})$	$I_C=5\text{A}, I_B=1\text{A}$			1.5	V
DC Current Gain	h_{FE}	$V_{CE}=5\text{V}, I_C=1\text{A}$		8		
Storage Time	t_{stg}	$I_C=5\text{A}, I_{B1}=1\text{A}, I_{B2}=-2\text{A}$			3.0	μs
Fall Time	t_f	$I_C=5\text{A}, I_{B1}=1\text{A}, I_{B2}=-2\text{A}$		0.1	0.2	μs

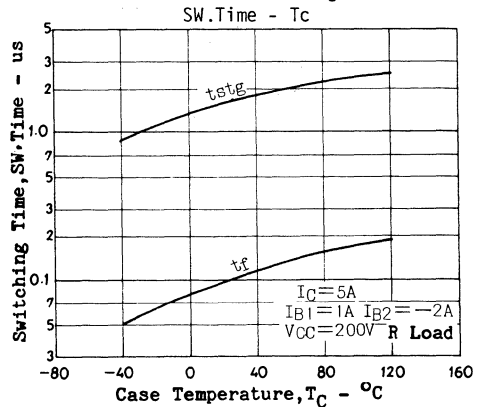
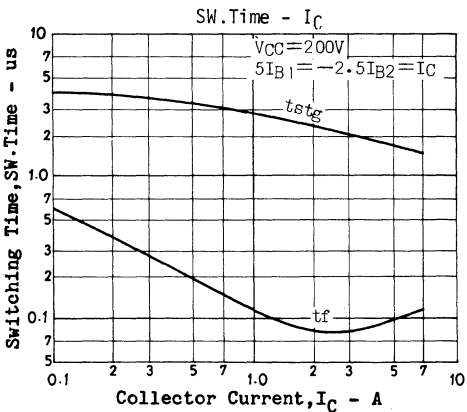
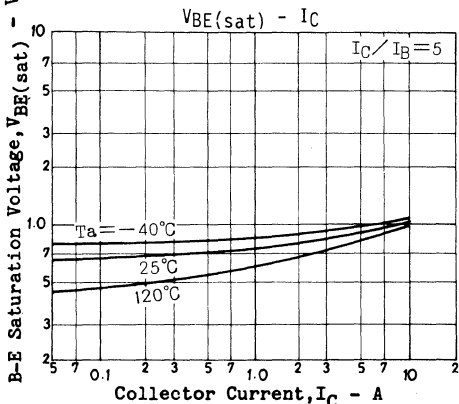
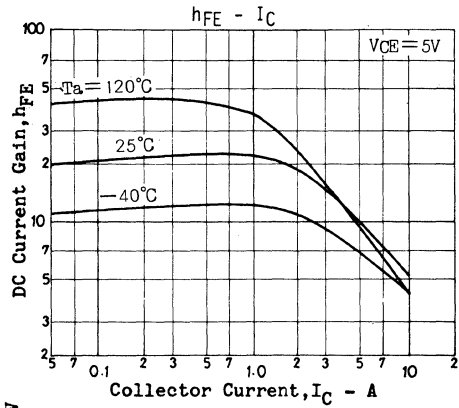
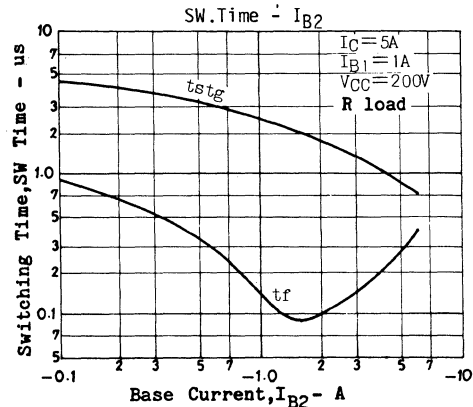
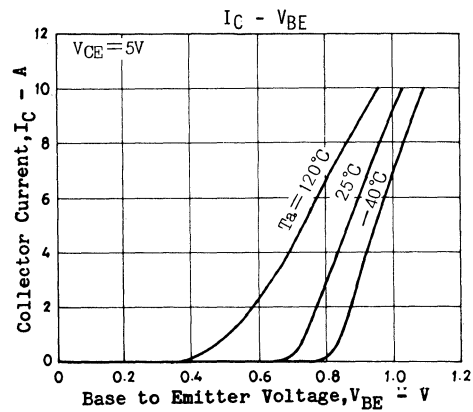
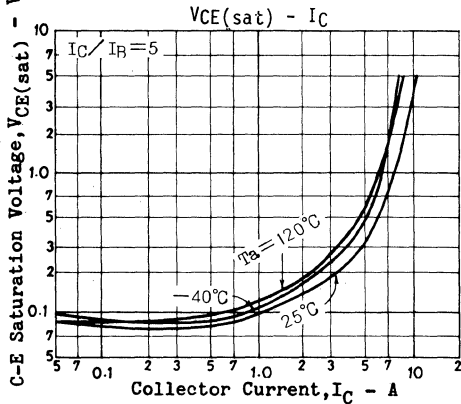
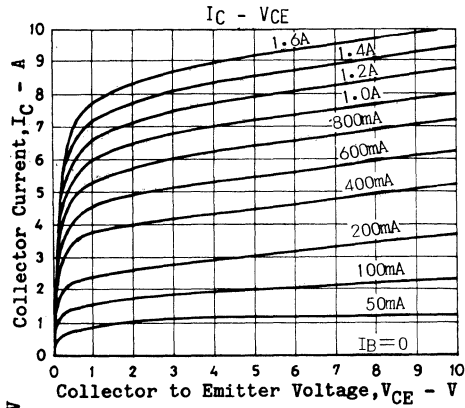
Switching Time Test Circuit

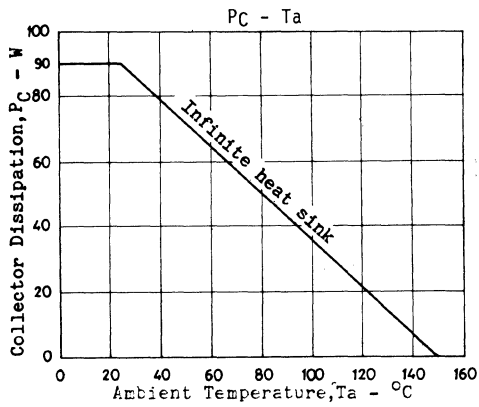
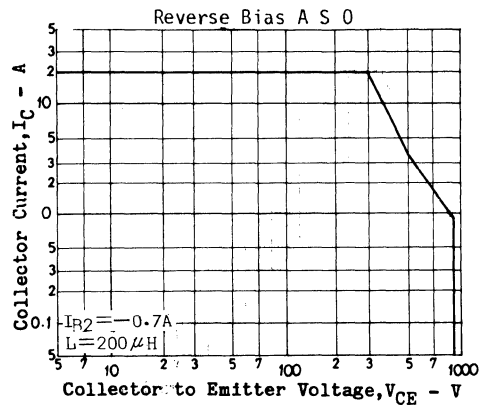
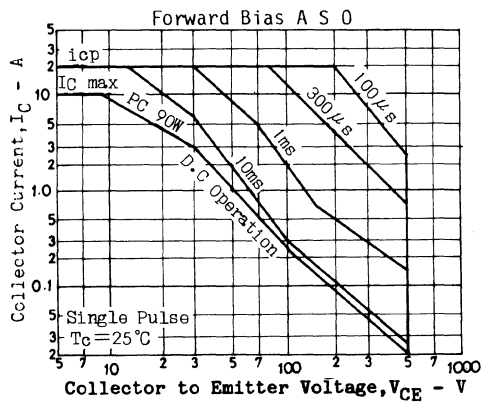


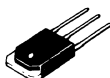
Case Outline 2022

(unit:mm)









2022

NPN Triple Diffused Planar Silicon Transistor

Very High-Definition CRT Display Horizontal Deflection Output Applications

(E)1637A

Features

- . High reliability (Adoption of HVP process)
- . Fast speed.
- . High breakdown voltage.
- . Adoption of MBIT process.

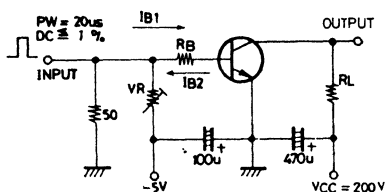
Absolute Maximum Ratings at Ta=25°C

Absolute Maximum Ratings at Ta=25°C		unit
Collector to Base Voltage	V _{CBO}	900 V
Collector to Emitter Voltage	V _{CEO}	500 V
Emitter to Base Voltage	V _{EBO}	7 V
Collector Current	I _C	15 A
Peak Collector Current	i _{cp}	25 A
Collector Dissipation	P _C	100 W
Junction Temperature	T _j	150 °C
Storage Temperature	T _{stg}	-55 to +150 °C

Electrical Characteristics at Ta=25°C

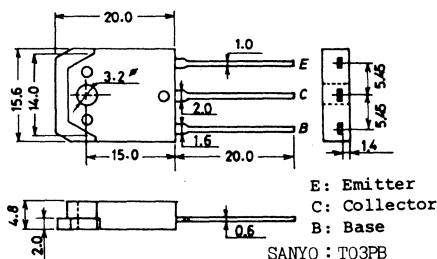
Electrical Characteristics at Ta=25°C			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=500V, I_E=0$			10	μA
	I_{CES}	$V_{CE}=900V, R_{BE}=0$			0.5	mA
Collector to Emitter Sustain Voltage	$V_{CEO(sus)}$	$I_C=100mA, I_B=0$	500			V
Emitter Cutoff Current	I_{EB0}	$V_{EB}=5V, I_C=0$			1	mA
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=7V, I_B=1.4A$			2	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=7A, I_B=1.4A$			1.5	V
DC Current Gain	h_{FE}	$V_{CE}=5V, I_C=1.4A$	8			
Storage Time	t_{stg}	$I_C=7A, I_{B1}=1.4A, I_{B2}=-2.8A$			3.0	μs
Fall Time	t_f	$I_C=7A, I_{B1}=1.4A, I_{B2}=-2.8A$		0.1	0.2	μs

Switching Time Test Circuit

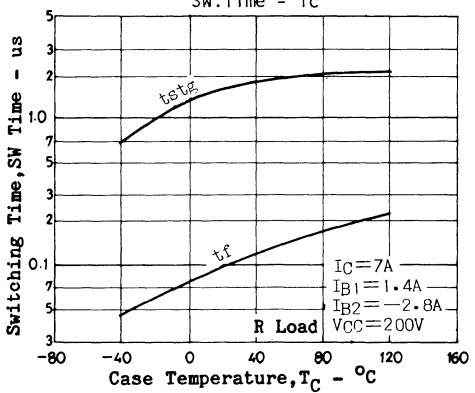
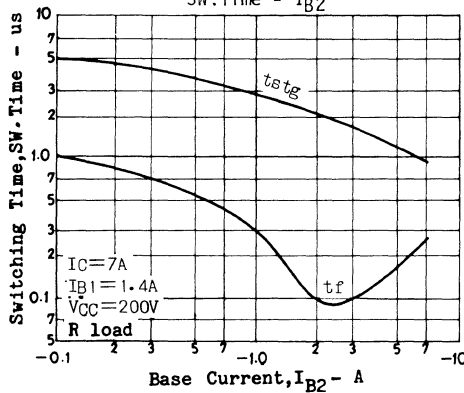
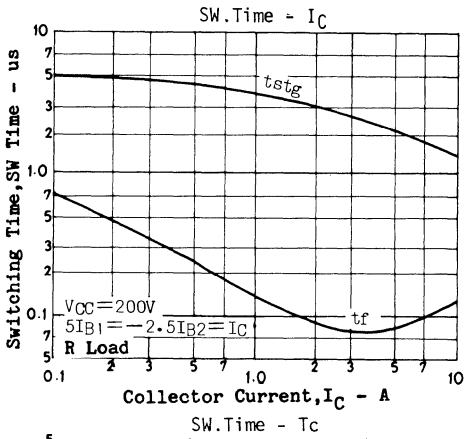
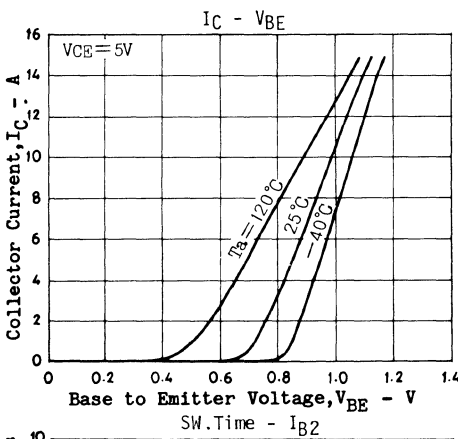
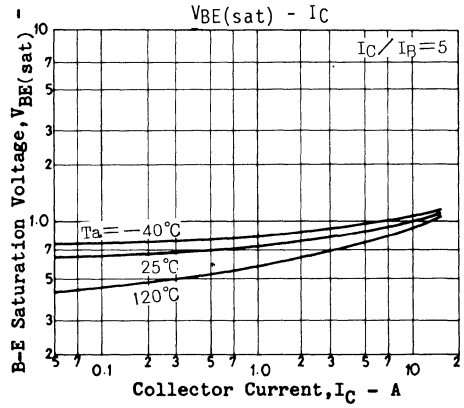
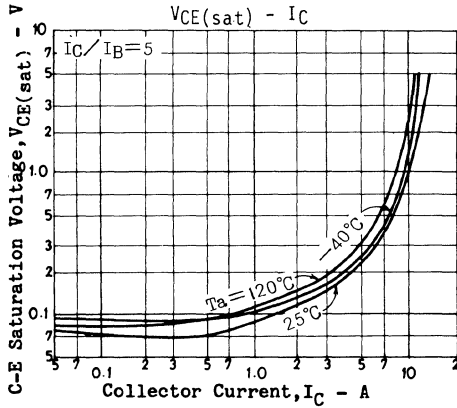
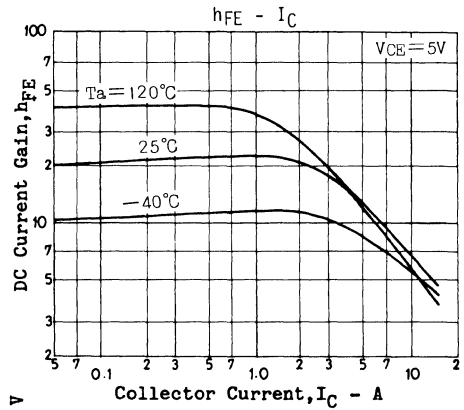
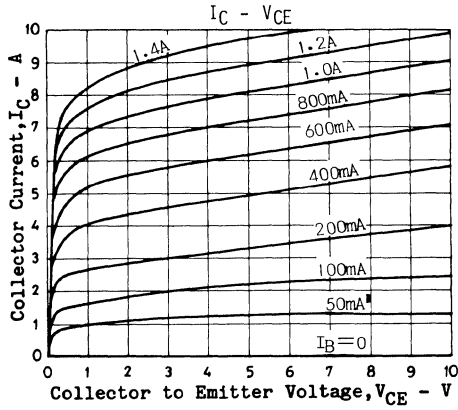


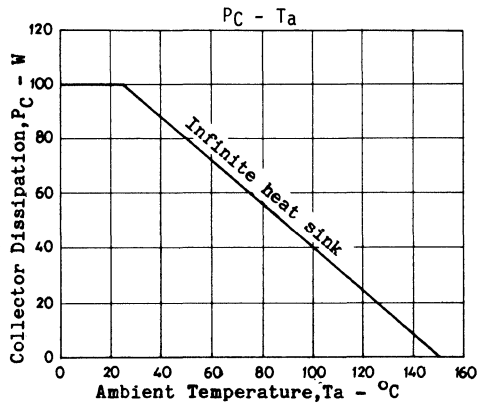
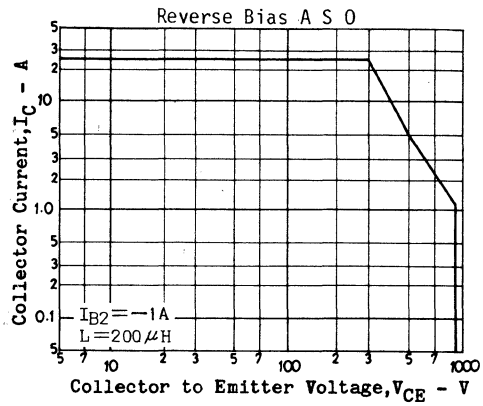
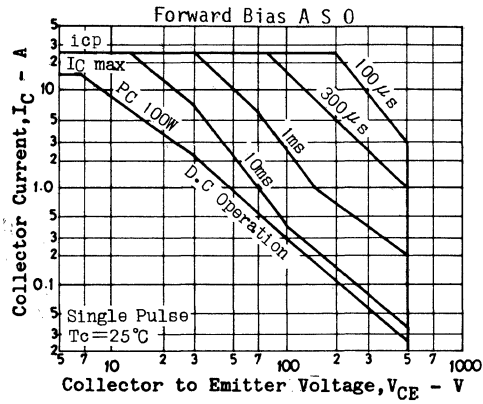
Case Outline 2022

(unit:mm)

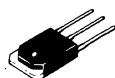


SANYO : T03PB





2SC3642



2022

NPN Triple Diffused Planar
Silicon Transistor

Very High-Definition CRT Display Horizontal Deflections Output Applications

©1626A

Features

- . High reliability (Adoption of HVP process)
- . Fast speed.
- . High breakdown voltage.
- . Adoption of MBIT process.

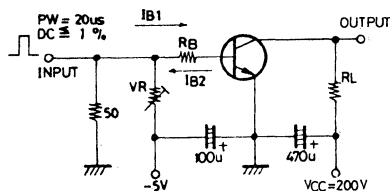
Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	1200	V
Collector to Emitter Voltage	V_{CE0}	800	V
Emitter to Base Voltage	V_{EB0}	7	V
Collector Current	I_C	6	A
Peak Collector Current	i_{cp}	12	A
Collector Dissipation	P_C	Infinite heat sink	100 W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

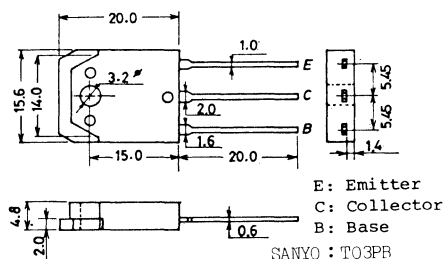
			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=800\text{V}, I_E=0$			10	μA
	I_{CES}	$V_{CE}=1200\text{V}, R_{BE}=0$			0.5	mA
Collector to Emitter	$V_{CE0(sus)}$	$I_C=100\text{mA}, I_B=0$	800			V
Sustain Voltage						
Emitter Cutoff Current	I_{EB0}	$V_{EB}=5\text{V}, I_C=0$			1	mA
Collector to Emitter	$V_{CE(sat)}$	$I_C=4\text{A}, I_B=0.8\text{A}$			5	V
Saturation Voltage						
Base to Emitter	$V_{BE(sat)}$	$I_C=4\text{A}, I_B=0.8\text{A}$			1.5	V
Saturation Voltage						
DC Current Gain	h_{FE}	$V_{CE}=5\text{V}, I_C=0.8\text{A}$	8			
Storage Time	t_{stg}	$I_C=4\text{A}, I_{B1}=0.8\text{A},$ $I_{B2}=-1.6\text{A}$			3.0	μs
Fall Time	t_f	$I_C=4\text{A}, I_{B1}=0.8\text{A},$ $I_{B2}=-1.6\text{A}$		0.1	0.2	μs

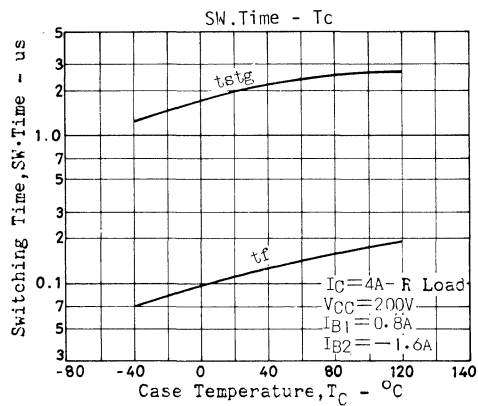
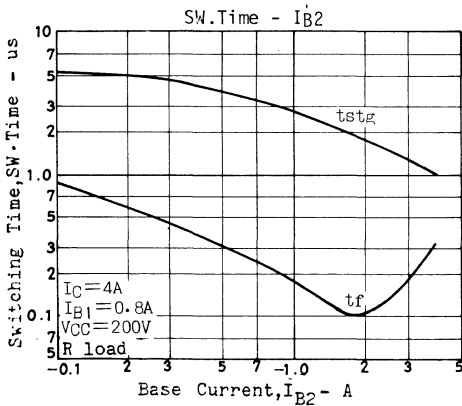
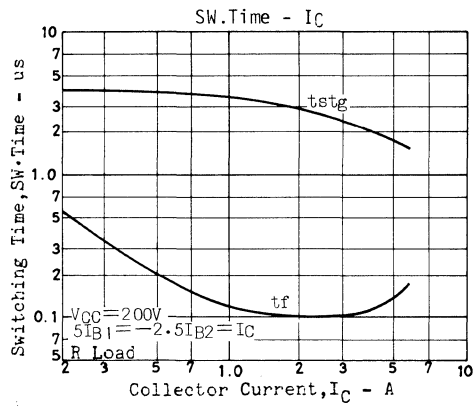
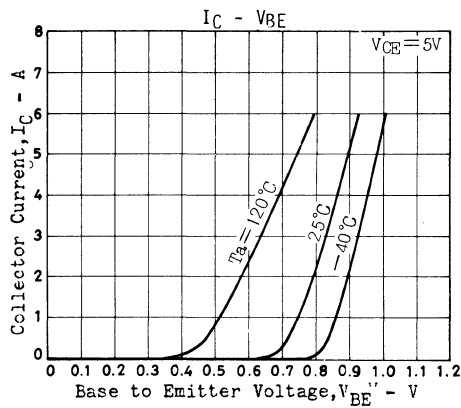
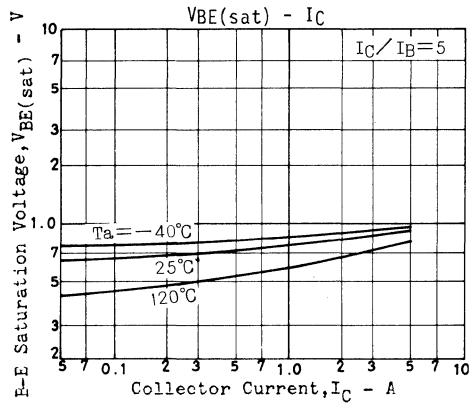
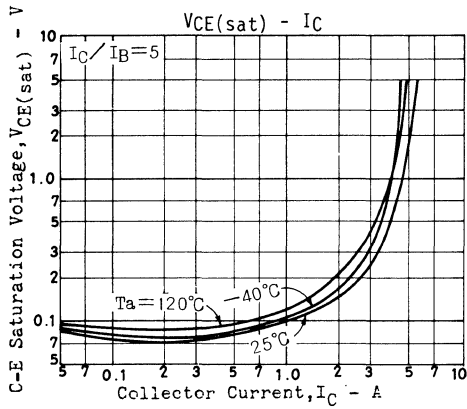
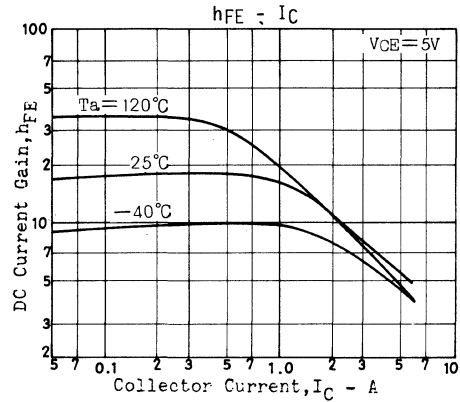
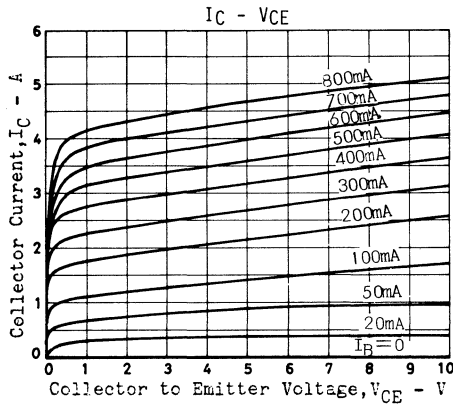
Switching Time Test Circuit

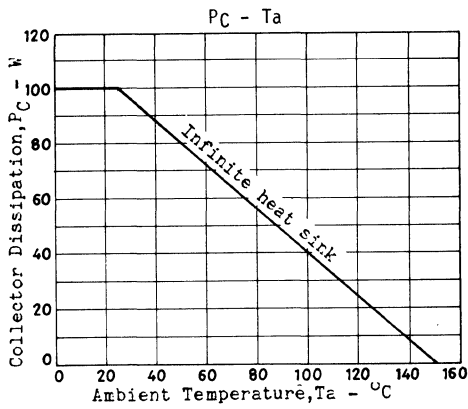
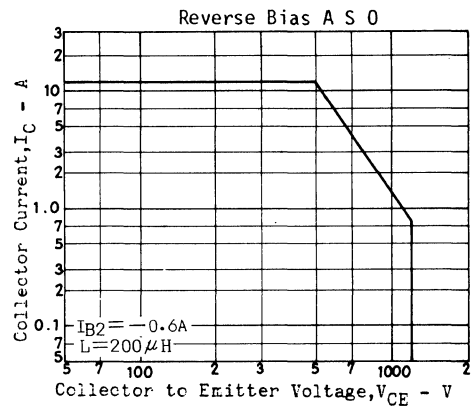
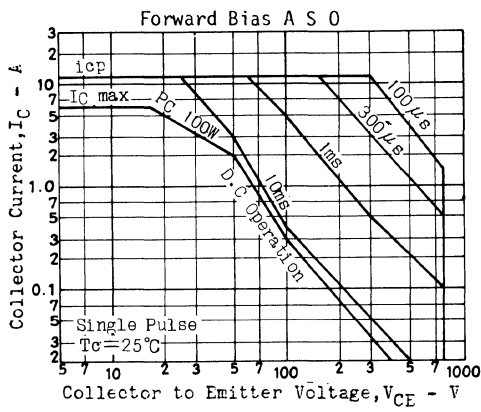


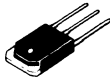
Case Outline 2022

(unit:mm)









2022

NPN Triple Diffused Planar Silicon Transistor

Very High-Definition CRT Display Horizontal Deflection Output Applications

Ⓔ1627A

Features

- . High reliability (Adoption of HVP process)
- . Fast speed.
- . High breakdown voltage.
- . Adoption of MBIT process.

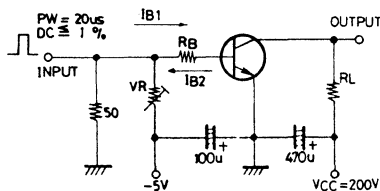
Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

Absolute Maximum Ratings at Ta=25°C			unit
Collector to Base Voltage	V _{CBO}	1200	V
Collector to Emitter Voltage	V _{CEO}	800	V
Emitter to Base Voltage	V _{EBO}	7	V
Collector Current	I _C	8	A
Peak Collector Current	i _{cp}	16	A
Collector Dissipation	P _C	140	W
Junction Temperature	T _j	150	°C
Storage Temperature	T _{stg}	-55 to +150	°C

Electrical Characteristics at Ta=25°C

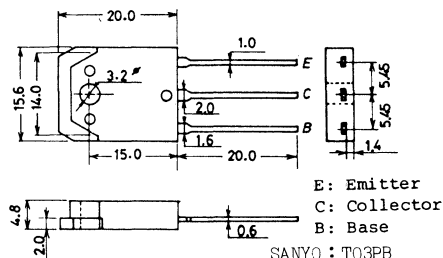
Electrical Characteristics at Ta=25°C			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800V, I_E=0$			10	μA
	I_{CES}	$V_{CE}=1200V, R_{BE}=0$			0.5	mA
Collector to Emitter Sustain Voltage	$V_{CEO(sus)}$	$I_C=100mA, I_B=0$	800			V
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			1	mA
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=6A, I_B=1.2A$			5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=6A, I_B=1.2A$			1.5	V
DC Current Gain	h_{FE}	$V_{CE}=5V, I_C=1.2A$	8			
Storage Time	t_{stg}	$I_C=6A, I_{B1}=1.2A, I_{B2}=-2.4A$			3.0	μs
Fall Time	t_f	$I_C=6A, I_{B1}=1.2A, I_{B2}=-2.4A$		0.1	0.2	μs

Switching Time Test Circuit

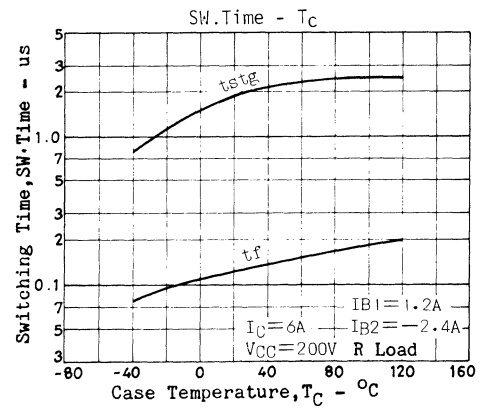
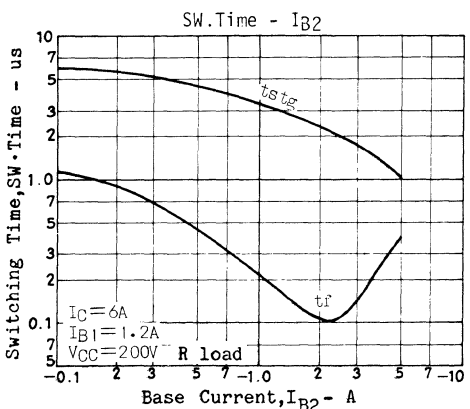
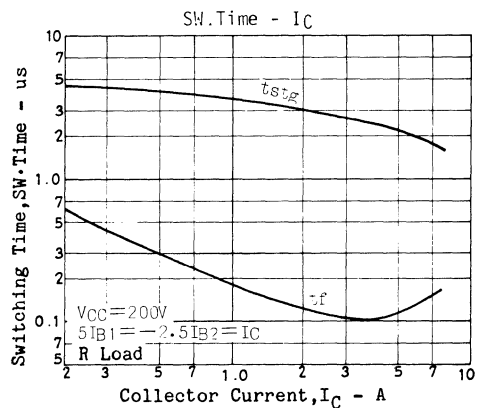
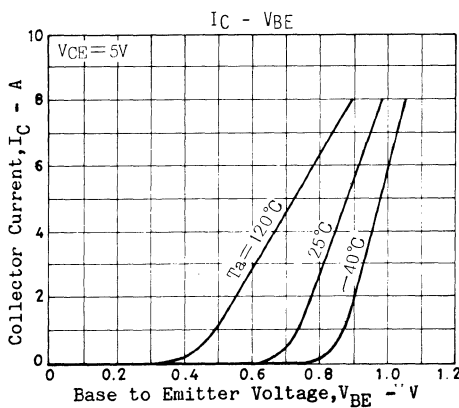
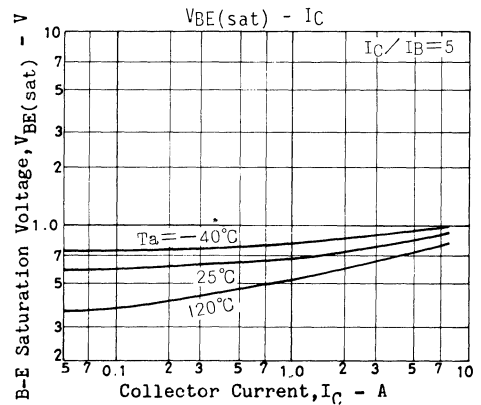
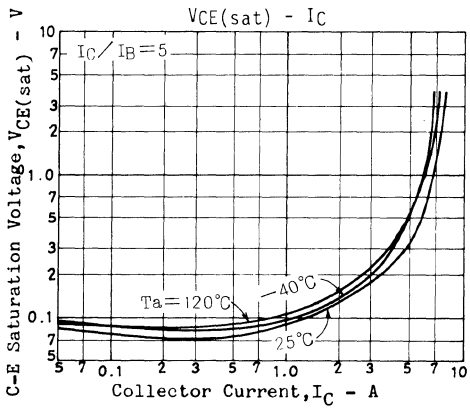
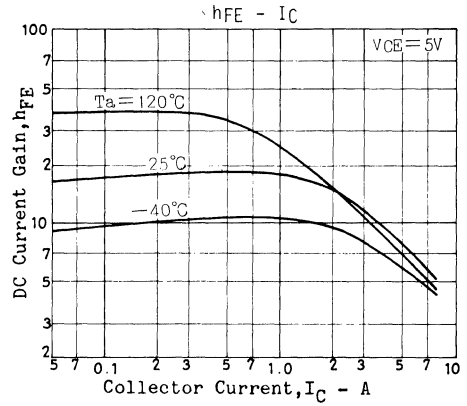
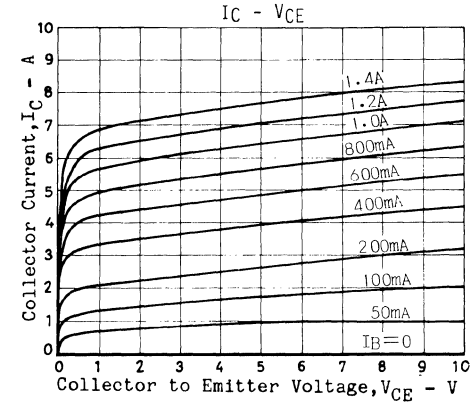


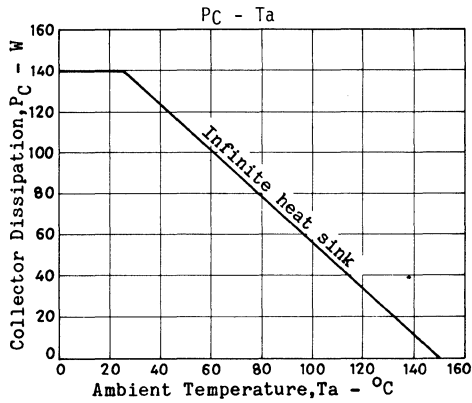
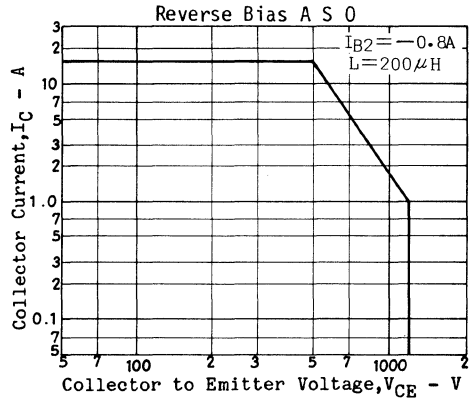
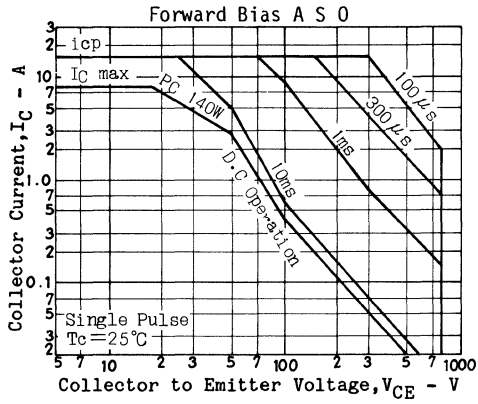
Case Outline 2022

(unit:mm)

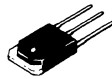


SANYO : T03PB





2SC3644



2022

NPN Triple Diffused Planar
Silicon Transistor

Very High-Definition CRT Display Horizontal Deflection Output Applications

©1628A

Features

- . High reliability (Adoption of HVP process)
- . Fast speed.
- . High breakdown voltage.
- . Adoption of MBIT process.

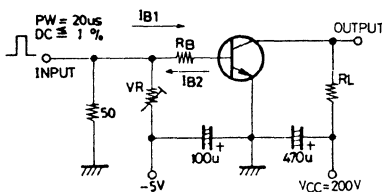
Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	1200	V
Collector to Emitter Voltage	V_{CE0}	800	V
Emitter to Base Voltage	V_{EB0}	7	V
Collector Current	I_C	12	A
Peak Collector Current	i_{cp}	25	A
Collector Dissipation	P_C	150	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

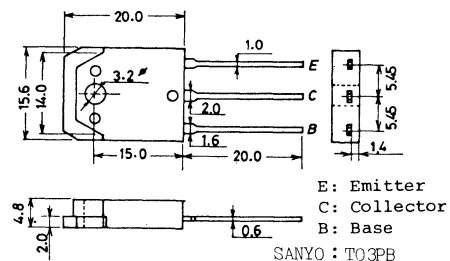
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800\text{V}, I_E=0$			10	μA
	I_{CES}	$V_{CE}=1200\text{V}, R_{BE}=0$			0.5	mA
Collector to Emitter Sustain Voltage	$V_{CEO(sus)}$	$I_C=100\text{mA}, I_B=0$	800			V
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5\text{V}, I_C=0$			1	mA
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=8\text{A}, I_B=1.6\text{A}$			5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=8\text{A}, I_B=1.6\text{A}$			1.5	V
DC Current Gain	h_{FE}	$V_{CE}=5\text{V}, I_C=1.6\text{A}$		8		
Storage Time	t_{stg}	$I_C=8\text{A}, I_{B1}=1.6\text{A}, I_{B2}=-3.2\text{A}$			3.0	μs
Fall Time	t_f	$I_C=8\text{A}, I_{B1}=1.6\text{A}, I_{B2}=-3.2\text{A}$		0.1	0.2	μs

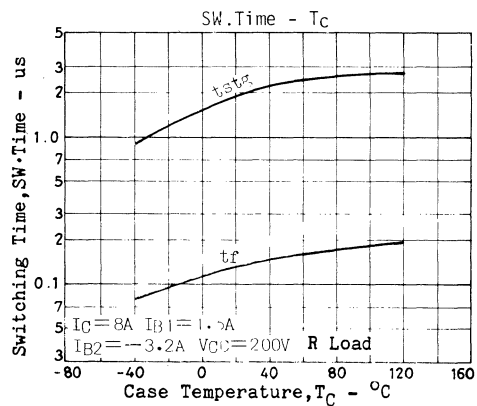
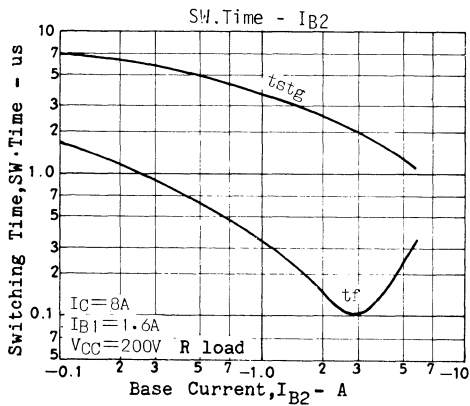
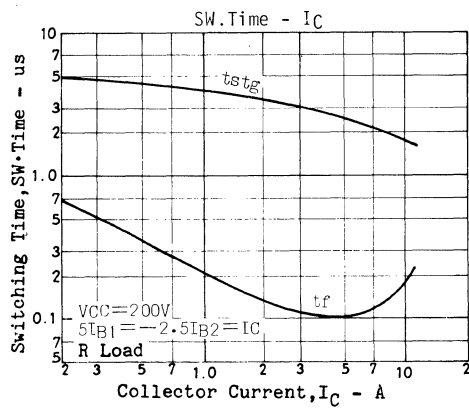
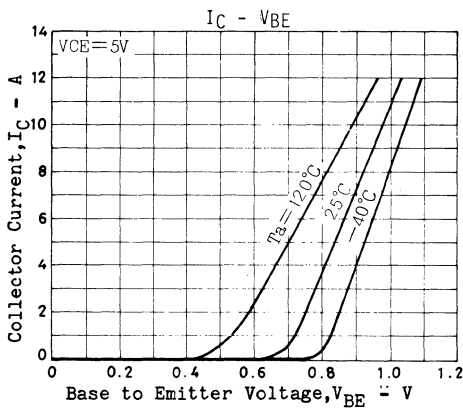
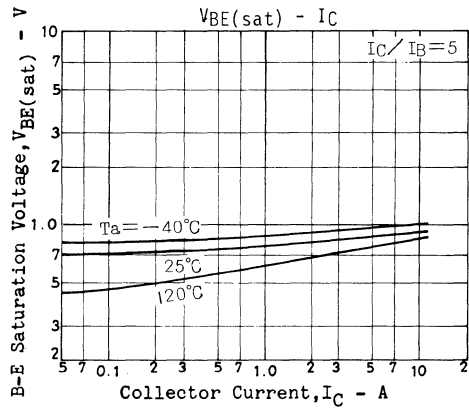
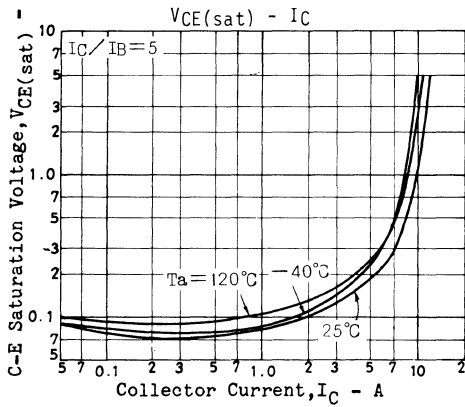
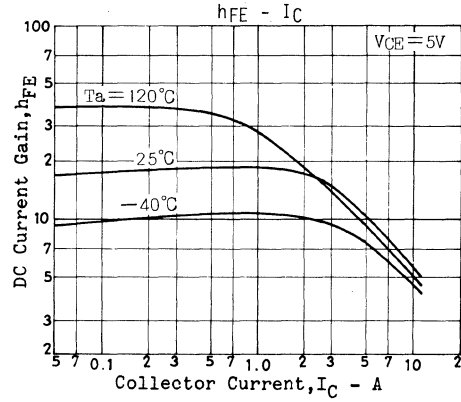
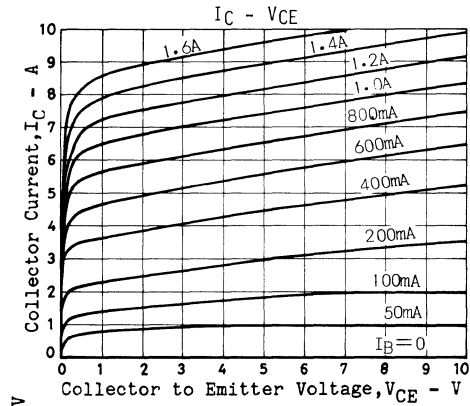
Switching Time Test Circuit

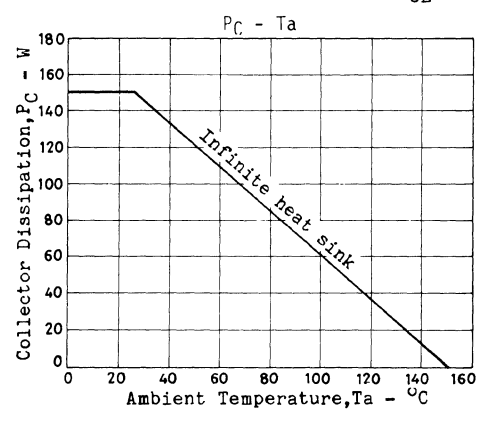
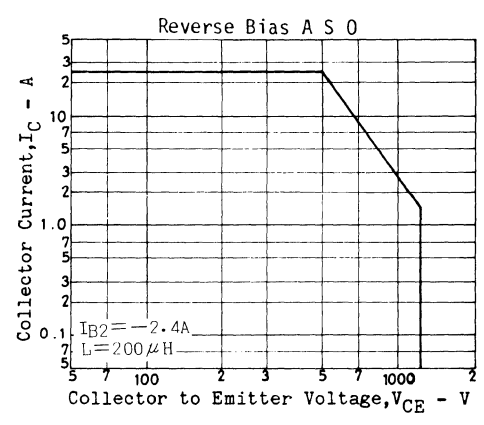
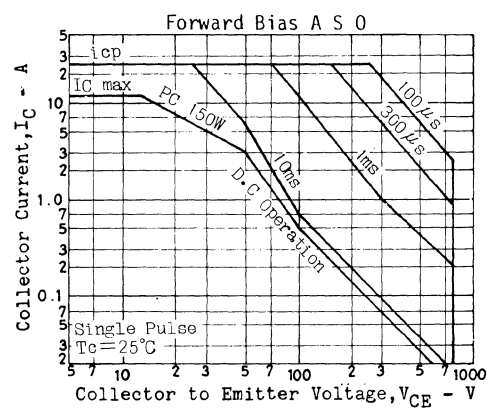


Case Outline 2022

(unit:mm)







2SC3645



2038

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1415

High Voltage Switching, Predriver Applications

©1720

Features

- . Adoption of FBET process.
- . High breakdown voltage ($V_{CE0}=160V$)
- . Excellent linearity of h_{FE} and small c_{ob} .
- . Fast switching speed.
- . Very small size making it easy to provide high-density, small-sized hybrid IC's

(): 2SA1415

Absolute Maximum Ratings at $T_a=25^{\circ}C$

			unit
Collector to Base Voltage	V_{CBO}	(-)180	V
Collector to Emitter Voltage	V_{CEO}	(-)160	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)140	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	$P_C(1)$	500	mW
	$P_C(2)$ Mounted on ceramic board (250mm ² x 0.8mm)	1.3	W
Junction Temperature	T_j	150	$^{\circ}C$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}C$

Electrical Characteristics at $T_a=25^{\circ}C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80V, I_E=0$			(-)100	nA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$			(-)100	nA
DC Current Gain	h_{FE}^*	$V_{CE}=(-)5V, I_C=(-)10mA$	100		400	
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)10mA$		150		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10V, f=1MHz$		(4.0)		pF
				3.0		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)50mA, I_B=(-)5mA$		(-0.14)	(-0.4)	V
				0.07	0.3	
Turn-ON Time	t_{on}	at specified Test Circuit		0.1		us
Storage Time	t_{stg}	"		1.5		us
Fall Time	t_f	"		0.1		us

* The 2SA1415/2SC3645 are classified by 10mA h_{FE} as follows:

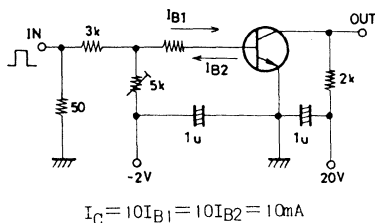
100	R	200	140	S	280	200	T	400
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Marking

2SA1415-----AA

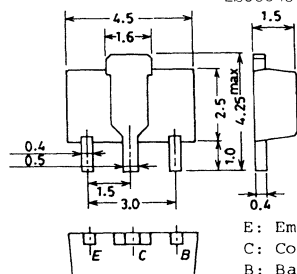
2SC3645-----CA

Switching Time Test Circuit



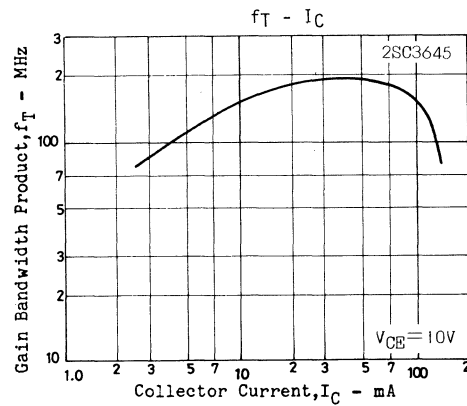
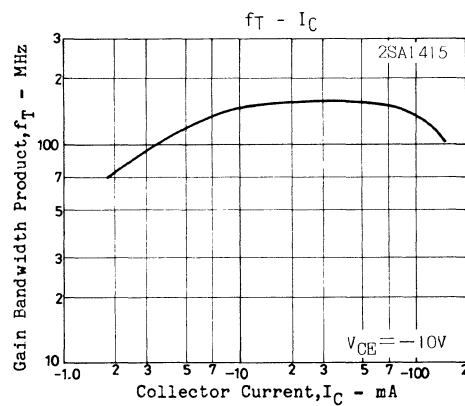
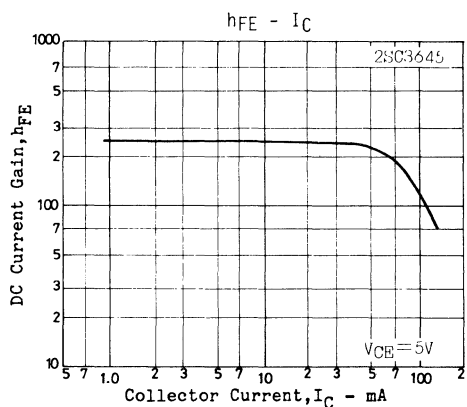
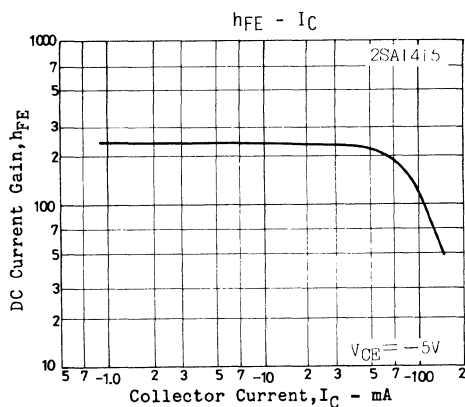
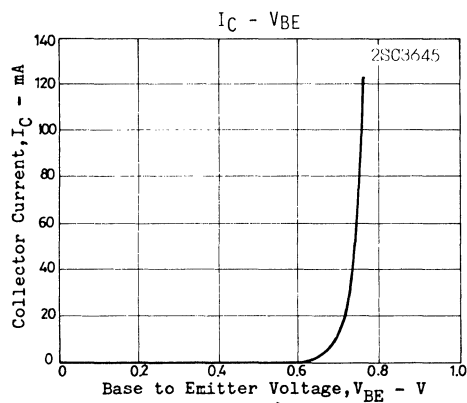
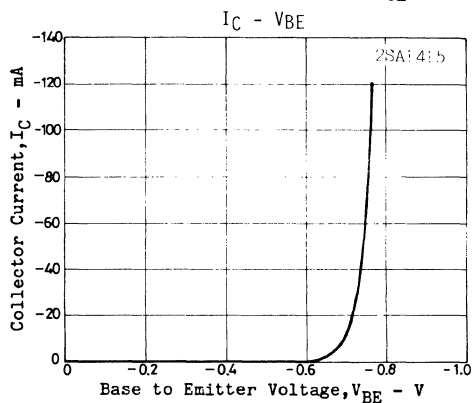
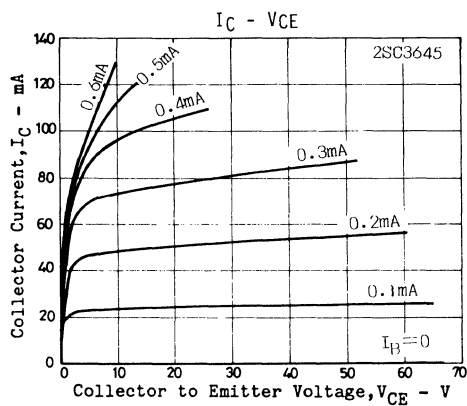
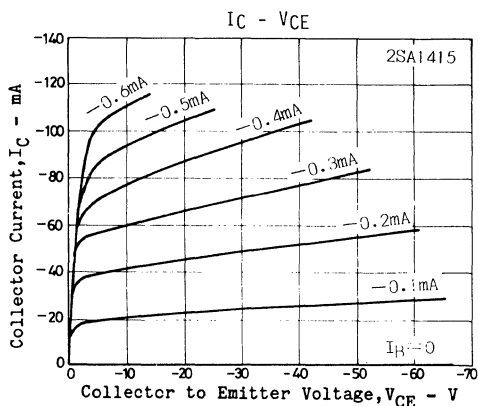
Case Outline 2038

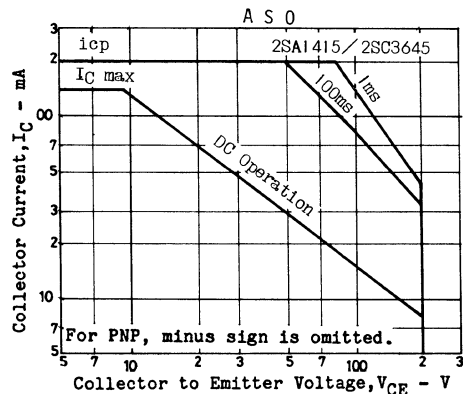
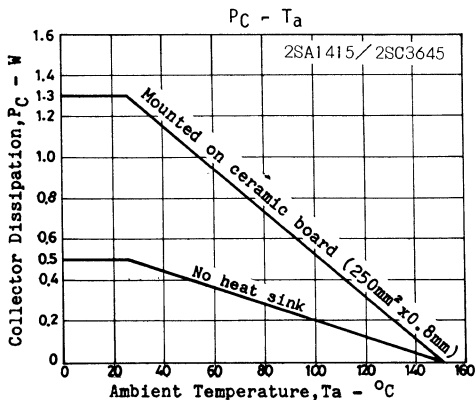
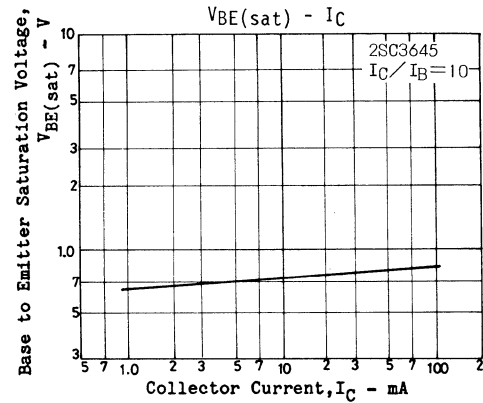
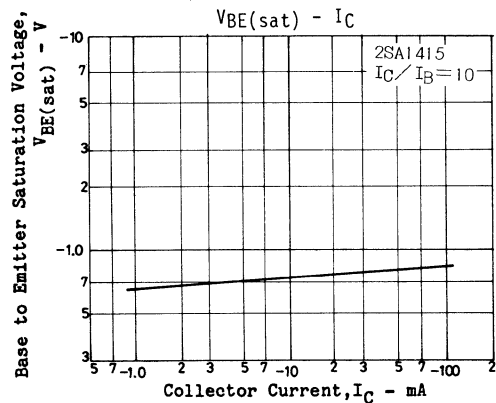
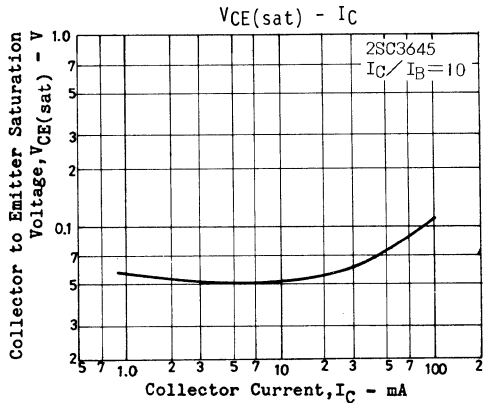
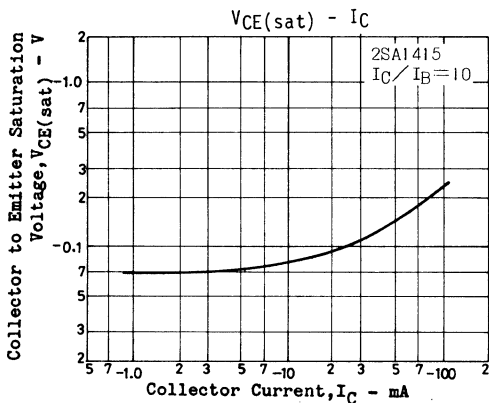
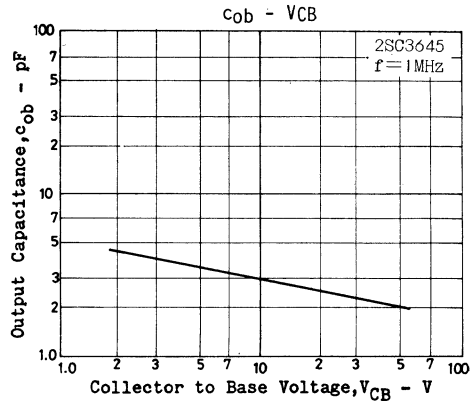
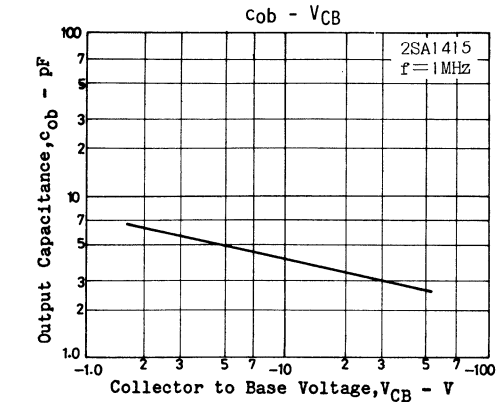
(unit:mm)



SANYO: PCP

2145MY, TS No.1720-1/3





2SC3648



2038

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1418

High Voltage Switching Applications

©1788

Applications

- Color TV audio output, converter, inverter.

Features

- Adoption of FBET, MBIT processes.
- High breakdown voltage and large current capacity.
- Fast switching speed.
- Very small size making it easy to provide high-density, small-sized hybrid IC's.

(): 2SA1418

Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CBO}	(-)180	V
Collector to Emitter Voltage	V_{CEO}	(-)160	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)0.7	A
Peak Collector Current	i_{cp}	(-)1.5	A
Collector Dissipation	P_C	500	mW
	P_C Mounted on ceramic board (250mm ² x0.8mm)	1.3	W
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

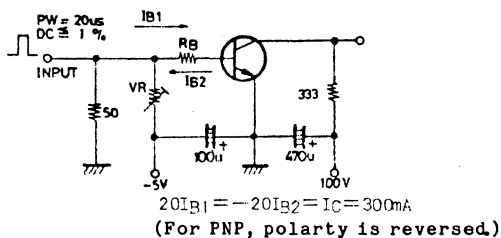
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)120V, I_E=0$			(-)0.1	uA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$			(-)0.1	uA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)5V, I_C=(-)100mA$	100		400	
	$h_{FE}(2)$	$V_{CE}=(-)5V, I_C=(-)10mA$	90			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		120		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)250mA, I_B=(-)25mA$		0.12	0.4	
				(-0.2)(-0.5)		V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)250mA, I_B=(-)25mA$		(-)0.85	(-)1.2	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10uA, I_E=0$		(-)180		V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$		(-)160		V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10uA, I_C=0$		(-)6		V

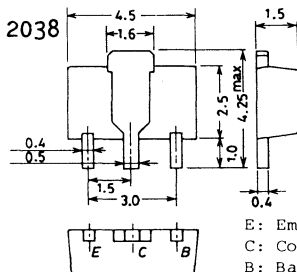
* The 2SA1418/2SC3648 are classified by 100mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400
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Switching Time Test Circuit



Case Outline 2038 (unit:mm)

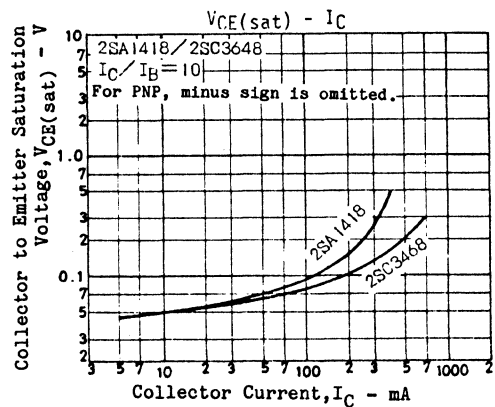
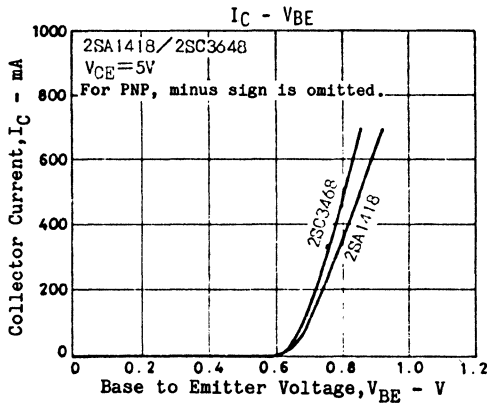
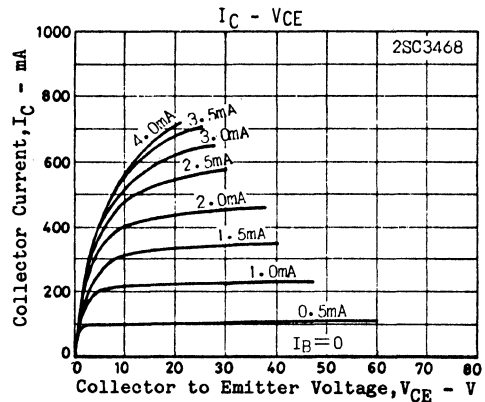
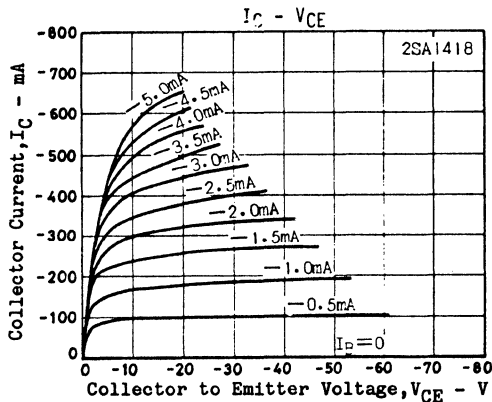
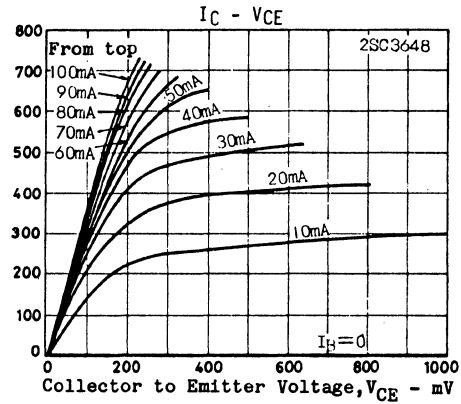
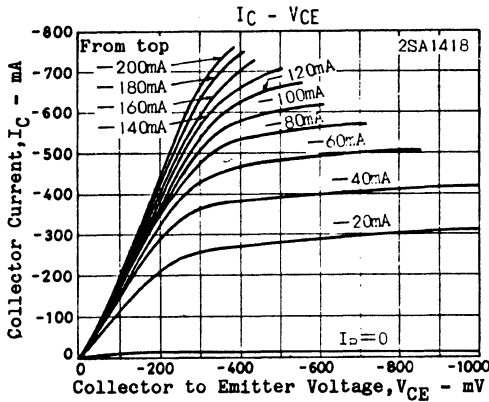


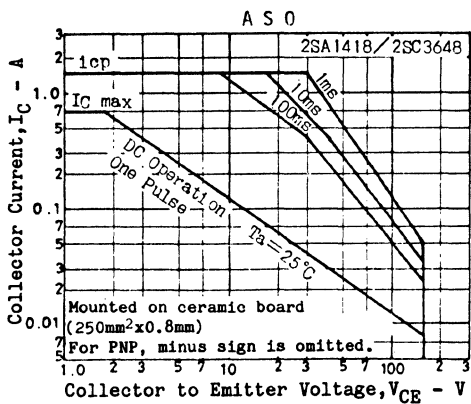
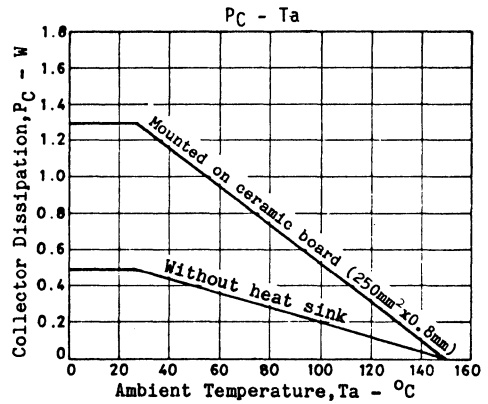
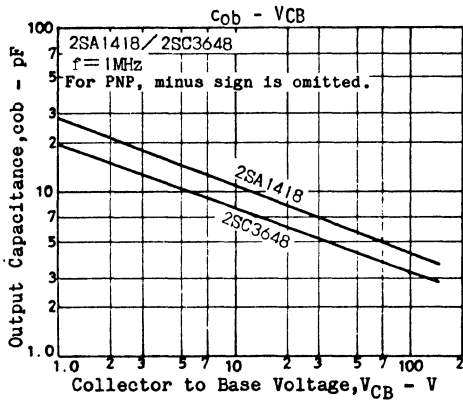
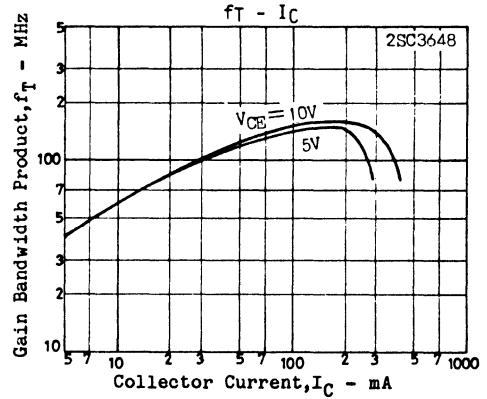
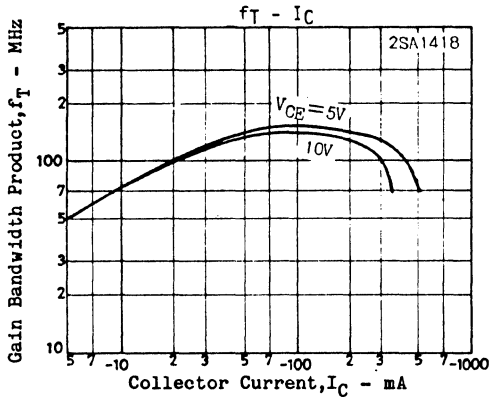
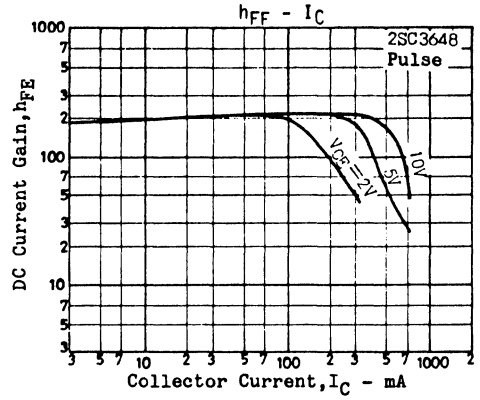
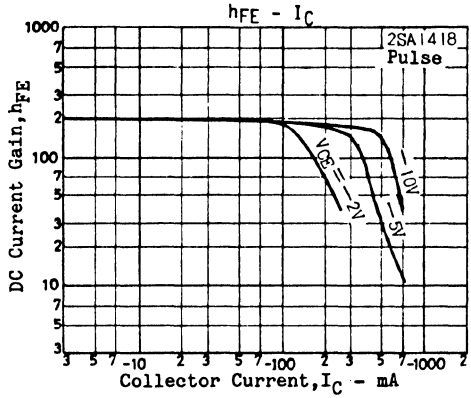
Marking
 2SA1418:AD
 2SC3648:CD

E: Emitter
 C: Collector
 B: Base

SANYO: PCP

			min	typ	max	unit
Output Capacitance	c_{ob}	$V_{CB}=(-)10V, f=1MHz$		8		pF
				(11)		pF
Turn-ON Time	t_{on}	at specified test circuit		50		ns
				(60)		ns
Storage Time	t_{stg}	"		1000		ns
		"		(900)		ns
Fall Time	t_f	"		60		ns
		"		(60)		ns





2SC3650



2038

NPN Epitaxial Planar
Silicon Transistor

High h_{FE} , Low Frequency, General-Purpose Amp Applications

(E)1780

Applications

- LF amp, various drivers, muting circuit

Features

- High DC current gain ($h_{FE}=800$ to 3200)
- Low collector-to-emitter saturation voltage [$V_{CE(sat)} \leq 0.5V$]
- Large current capacity ($I_C=1.2V$)
- Very small size making it easy to provide high-density, small-sized hybrid IC's.

Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	30	V
Collector to Emitter Voltage	V_{CEO}	25	V
Emitter to Base Voltage	V_{EBO}	15	V
Collector Current	I_C	1.2	A
Peak Collector Current	i_{cp}	2	A
Collector Dissipation	P_C	500	mW
	P_C^*	1.5	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

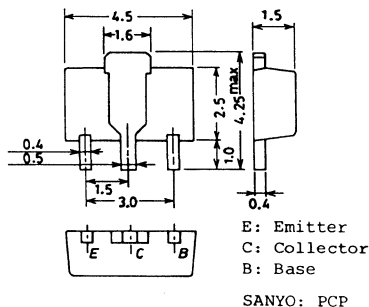
* Mounted on ceramic board (250mm²x0.8mm)

Electrical Characteristics at $T_a=25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=20V, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=10V, I_C=0$			0.1	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5V, I_C=500mA$	800	1500	3200	
	$h_{FE}(2)$	$V_{CE}=5V, I_C=10mA$	600			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=50mA$		220		MHz
Output Capacitance	c_{ob}	$V_{CB}=10V, f=1MHz$		17		pF
Collector to Emitter	$V_{CE(sat)}$	$I_C=500mA, I_B=10mA$	0.12	0.5		V
Saturation Voltage						

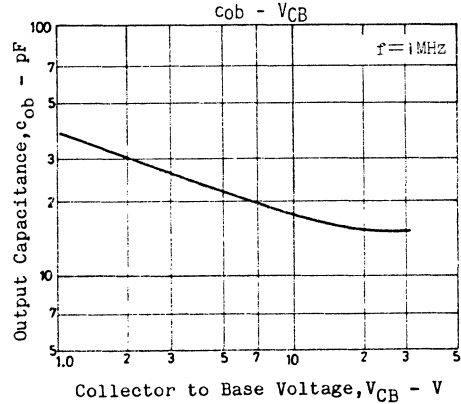
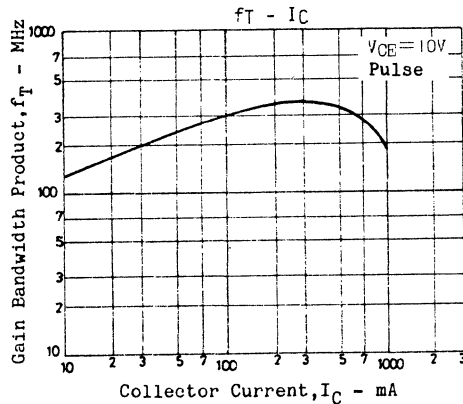
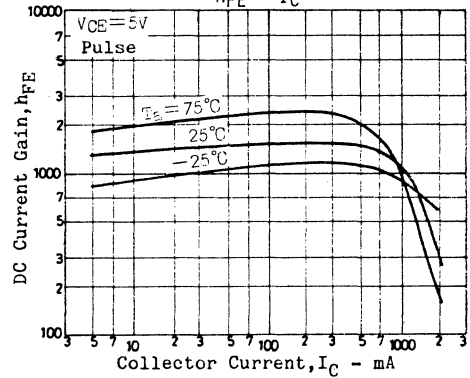
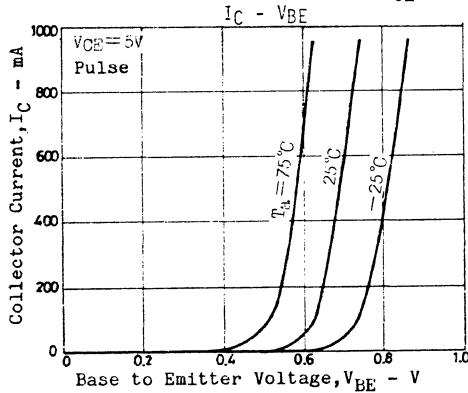
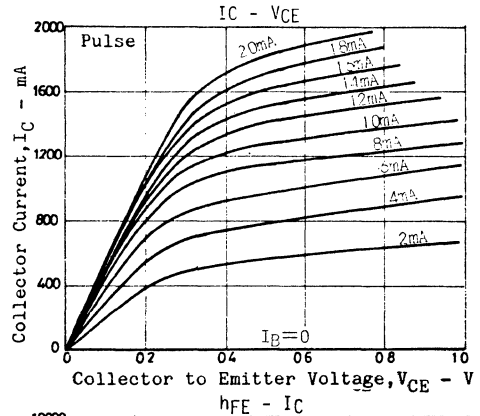
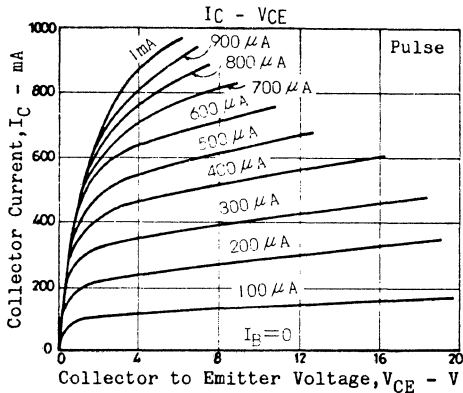
Case Outline 2038

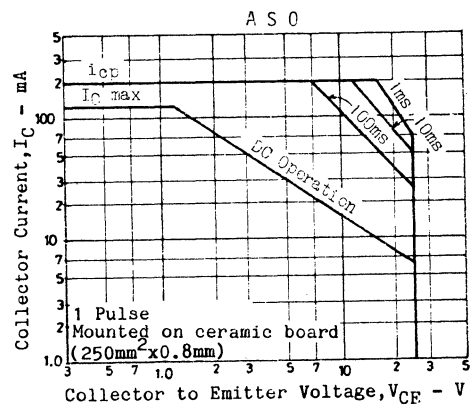
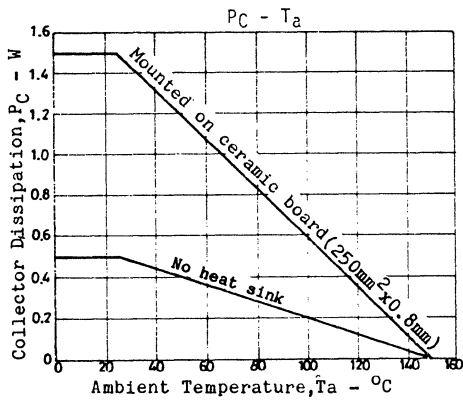
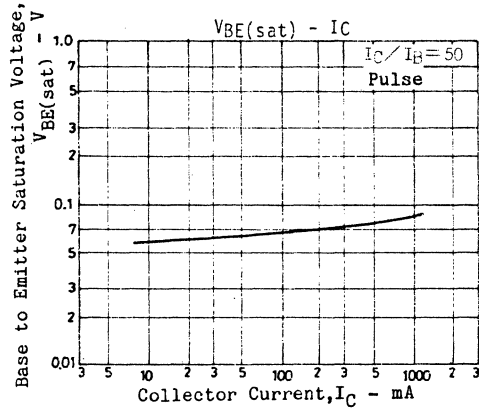
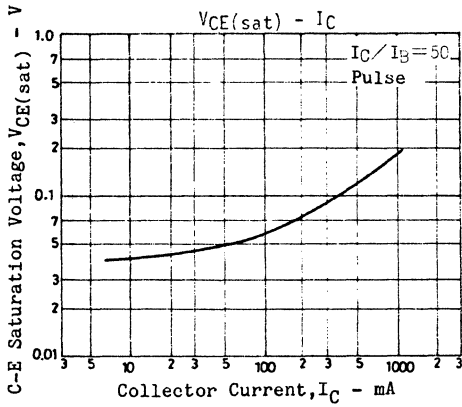
(unit:mm)



2145KI, TS No.1780-1/3

Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=500mA, I_E=10mA$	min 0.85	typ 1.2	max	unit V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu A, I_E=0$	30			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, I_B=0$	25			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu A, I_C=0$	15			V





2SC3651



2038

NPN Epitaxial Planar
Silicon Transistor

High h_{FE} , Low Frequency, General-Purpose Amp Applications

©1779

Applications

- . LF amp, various drivers, muting circuit

Features

- . High DC current gain ($h_{FE}=500$ to 2000)
- . High breakdown voltage ($V_{CEO} \geq 100V$)
- . Low collector-to-emitter saturation voltage [$V_{CE(sat)} \leq 0.5V$]
- . High V_{EBO} ($V_{EBO} \geq 15V$)
- . Very small size making it easy to provide high-density, small-sized hybrid IC's.

Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	120	V
Collector to Emitter Voltage	V_{CEO}	100	V
Emitter to Base Voltage	V_{EBO}	15	V
Collector Current	I_C	200	mA
Peak Collector Current	i_{cp}	300	mA
Collector Dissipation	P_C	500	mW
	P_C^*	1.3	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

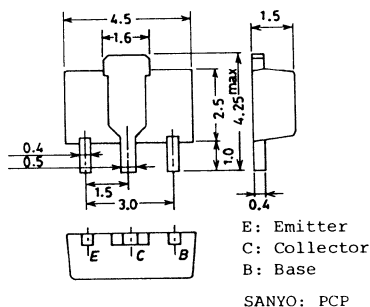
* Mounted on ceramic board ($250mm^2 \times 0.8mm$)

Electrical Characteristics at $T_a=25^\circ C$

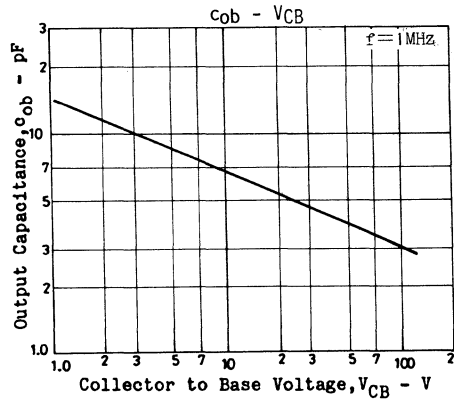
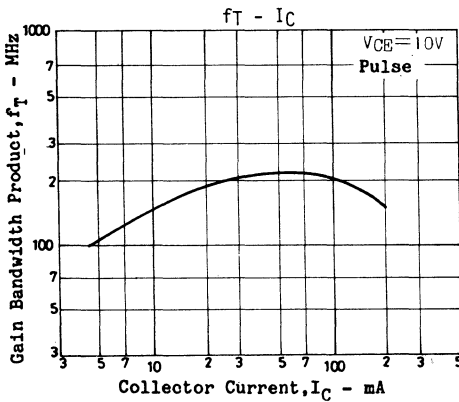
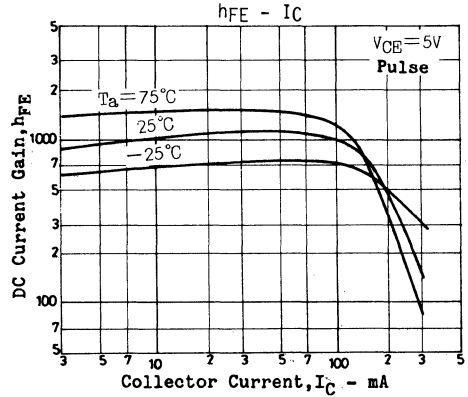
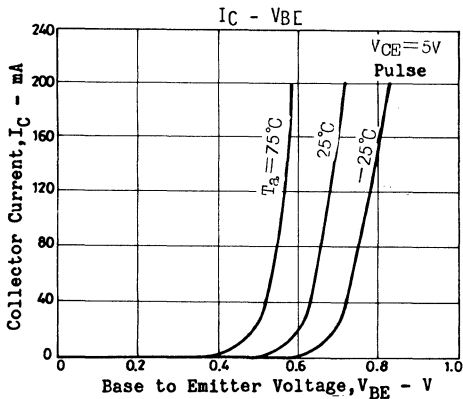
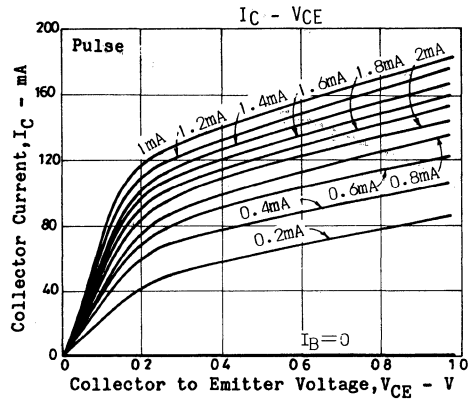
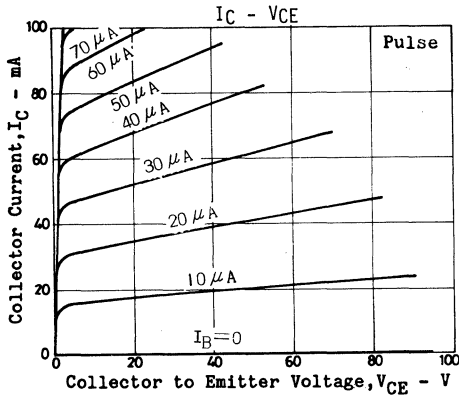
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=80V, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=10V, I_C=0$			0.1	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=5V, I_C=10mA$	500	1000	2000	
	$h_{FE}(2)$	$V_{CE}=5V, I_C=100mA$	400			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=10mA$		150		MHz
Output Capacitance	c_{ob}	$V_{CB}=10V, f=1MHz$		6.5		pF
Collector to Emitter	$V_{CE(sat)}$	$I_C=100mA, I_B=2mA$	0.15	0.5		V
Saturation Voltage						

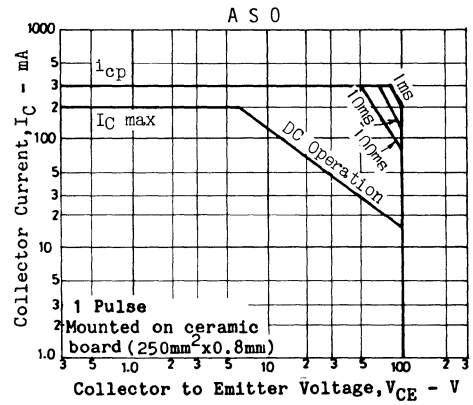
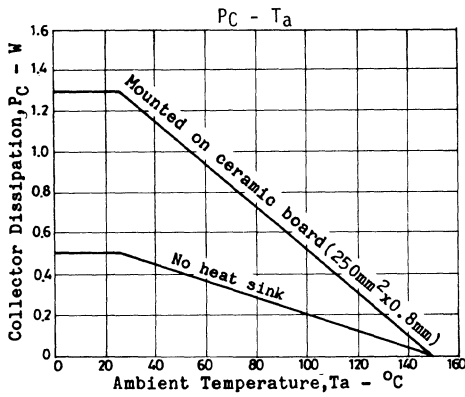
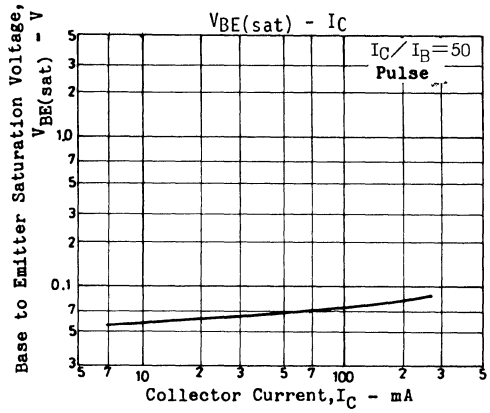
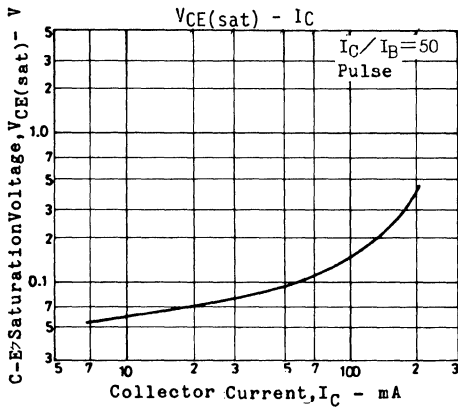
Case Outline 2038

(unit:mm)



Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=100mA, I_E=2mA$	min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10uA, I_E=0$	120			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, I_B=0$	100			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10uA, I_C=0$	15			V





2SC3653



2003A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1420

Switching Applications (with Bias Resistance)

©1682

Use

- . Switching circuit, inverter circuit, interface circuit, driver circuit

Features

- . With bias resistor ($R_1=47\text{kohm}$, $R_2=47\text{kohm}$).

(): 2SA1420

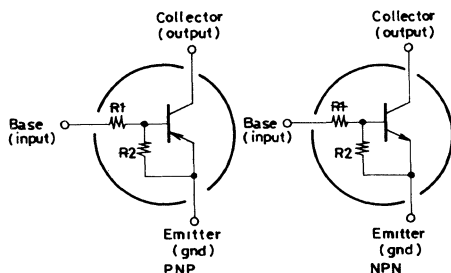
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)50	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)10	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	400	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

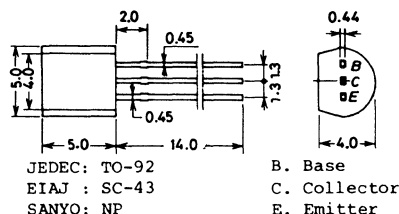
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)40\text{V}, I_E=0$		(-)0.1		μA
Collector Cutoff Current	I_{CE0}	$V_{CE}=(-)40\text{V}, I_B=0$		(-)0.5		μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)5\text{V}, I_C=0$	(-)30	(-)53	(-)80	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}, I_C=(-)5\text{mA}$	50			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)5\text{mA}$		250		MHz
				(200)		
Output Capacitance	C_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		3.7		pF
				(5.5)		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{mA}, I_B=(-)0.25\text{mA}$	(-)0.1	(-)0.3		V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)50			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu\text{A}, R_{BE}=\infty$	(-)50			V

Electrical Connection

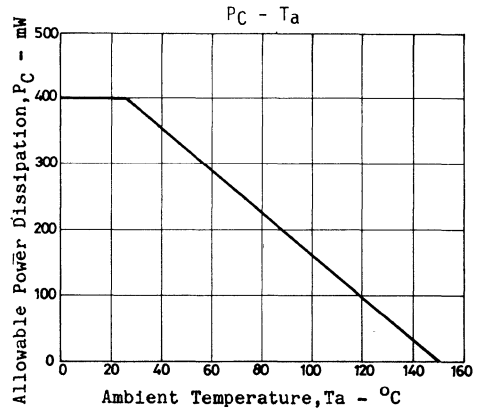
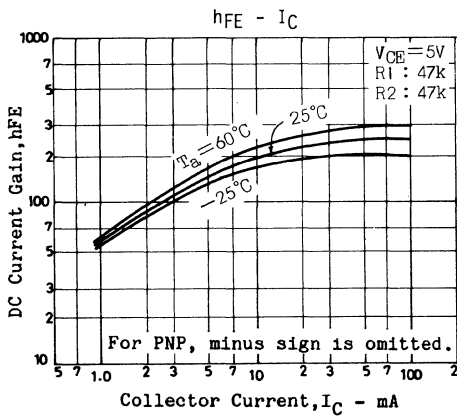
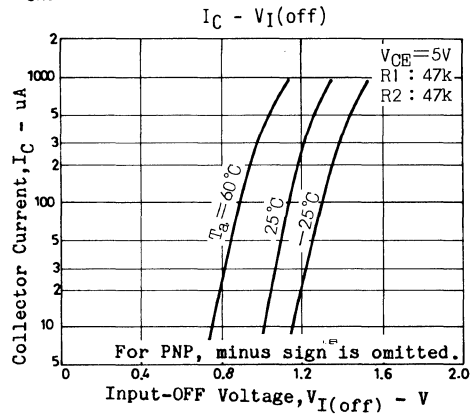
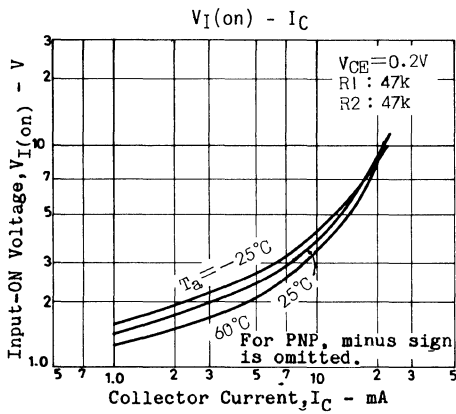
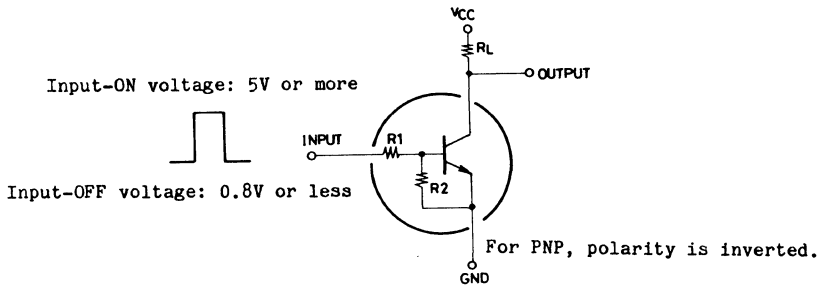


Case Outline 2003A (unit:mm)



		min	typ	max	unit
Input-OFF Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	$(-)0.8$	$(-)1.1$	$(-)1.5$ V
Input-ON Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)5mA$	$(-)1.0$	$(-)2.5$	$(-)5.0$ V
Input Resistance	R_1		32	47	62 kohm
Resistance Ratio	R_1/R_2		0.9	1.0	1.1 -

Sample Application Circuit



2SC3654



2003A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1421

Switching Applications (with Bias Resistance)

©1683

Use

- . Switching circuit, inverter circuit, interface circuit, driver circuit

Features

- . With bias resistor ($R_1=22\text{kohm}$, $R_2=22\text{kohm}$).

(): 2SA1421

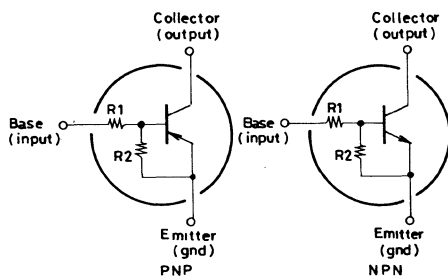
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)50	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)10	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	400	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

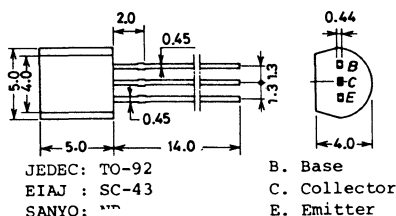
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)40\text{V}, I_E=0$		(-)0.1		μA
Collector Cutoff Current	I_{CE0}	$V_{CE}=(-)40\text{V}, I_B=0$		(-)0.5		μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)5\text{V}, I_C=0$	(-)70	(-)113	(-)150	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}, I_C=(-)5\text{mA}$	50			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)5\text{mA}$		250		MHz
				(200)		
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		3.7		pF
				(5.5)		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)10\text{mA}, I_B=(-)0.5\text{mA}$	(-)0.1	(-)0.3		V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)50			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu\text{A}, R_{BE}=\infty$	(-)50			V

Electrical Connection



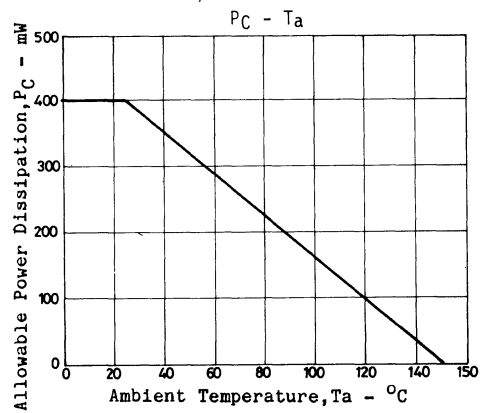
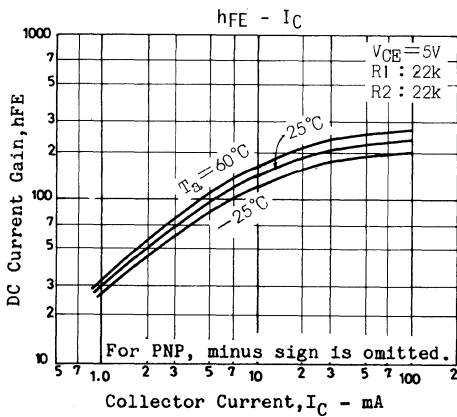
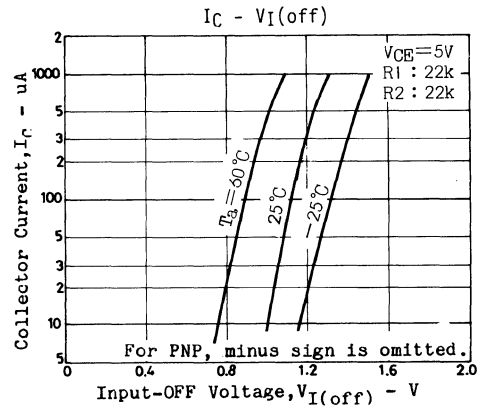
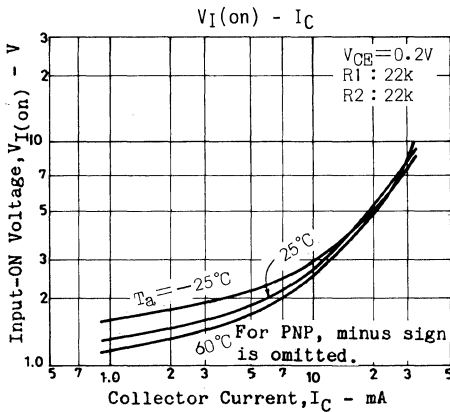
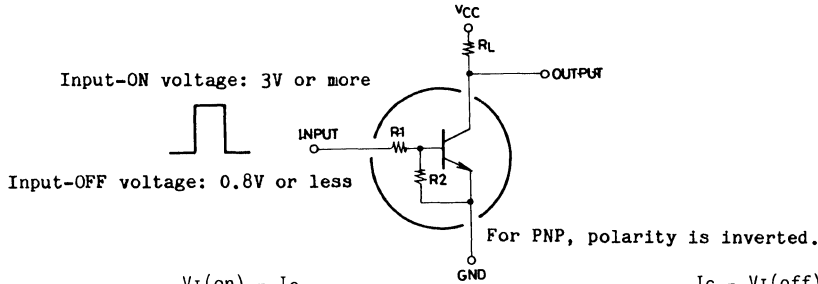
Case Outline 2003A (unit:mm)



B. Base
C. Collector
E. Emitter

			min	typ	max	unit
Input-OFF Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	-0.8	-1.1	-1.5	V
Input-ON Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)5mA$	-1.0	-1.9	-3.0	V
Input Resistance	R_1		15	22	29	kohm
Resistance Ratio	R_1/R_2		0.9	1.0	1.1	-

Sample Application Circuit



2SC3655



2003A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1422

Switching Applications (with Bias Resistance)

©1684

Use

- Switching circuit, inverter circuit, interface circuit, driver circuit

Features

- With bias resistor ($R_1=46\text{kohm}$, $R_2=23\text{kohm}$).

(): 2SA1422

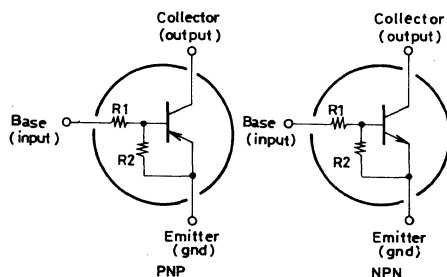
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)50	V
Collector to Emitter Voltage	V_{CEO}	(-)50	V
Emitter to Base Voltage	V_{EBO}	(-)10	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	400	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

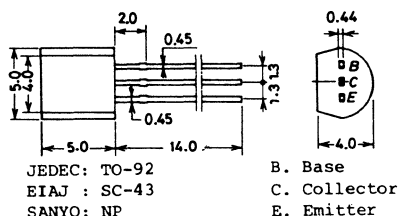
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			(-)0.1	μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}, I_B=0$			(-)0.5	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$	(-)40	(-)72	(-)100	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}, I_C=(-)5\text{mA}$	50			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)5\text{mA}$		250		MHz
				(200)		
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		3.7		pF
				(5.5)		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{mA}, I_B=(-)0.25\text{mA}$	(-)0.1	(-)0.3		V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)50			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu\text{A}, R_{BE}=\infty$	(-)50			V

Electrical Connection

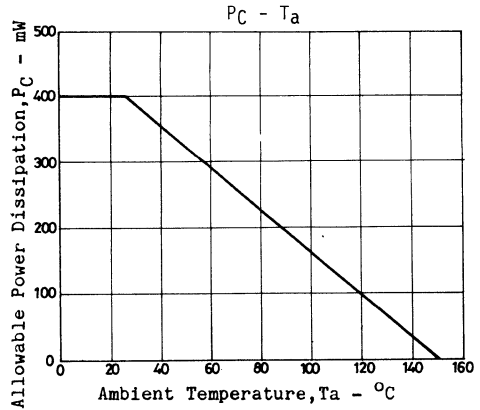
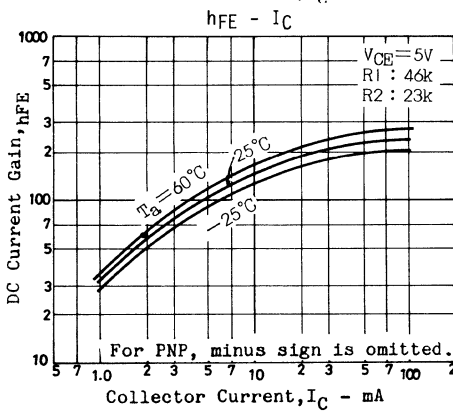
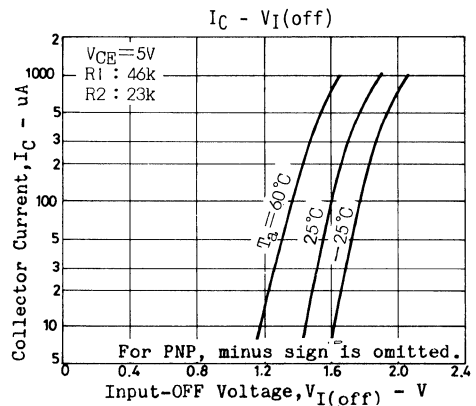
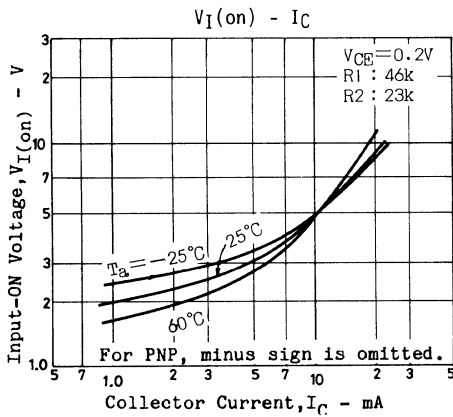
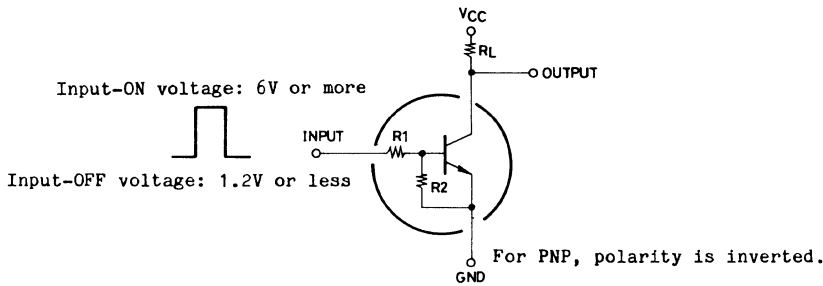


Case Outline 2003A (unit:mm)



		min	typ	max	unit
Input-OFF Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	(-)1.2(-)1.6(-)2.3		V
Input-ON Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)5mA$	(-)1.5(-)3.1(-)6.0		V
Input Resistance	R_1		32 46 60		kohm
Resistance Ratio	R_1/R_2		1.8 2.0 2.2		-

Sample Application Circuit



2SC3656



2003A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SA1423

Switching Applications (with Bias Resistance)

©1685

Use

- Switching circuit, inverter circuit, interface circuit, driver circuit

Features

- With bias resistor ($R_1=10\text{kohm}$, $R_2=10\text{kohm}$).

(): 2SA1423

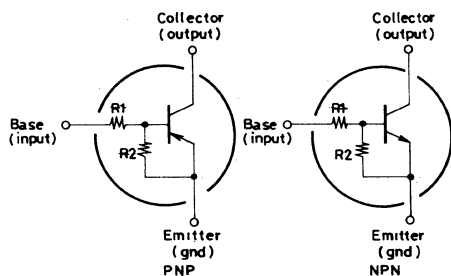
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)50	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)10	V
Collector Current	I_C	(-)100	mA
Peak Collector Current	i_{cp}	(-)200	mA
Collector Dissipation	P_C	400	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

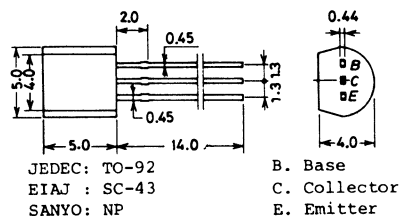
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$		(-)0.1		μA
Collector Cutoff Current	I_{CEO}	$V_{CE}=(-)40\text{V}, I_B=0$		(-)0.5		μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$	(-)170	(-)250	(-)330	μA
DC Current Gain	h_{FE}	$V_{CE}=(-)5\text{V}, I_C=(-)10\text{mA}$	50			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)5\text{mA}$		250		MHz
				(200)		
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		3.7		pF
				(5.5)		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)10\text{mA}, I_B=(-)0.5\text{mA}$	(-)0.1	(-)0.3		V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)50			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)100\mu\text{A}, R_{BE}=\infty$	(-)50			V

Electrical Connection



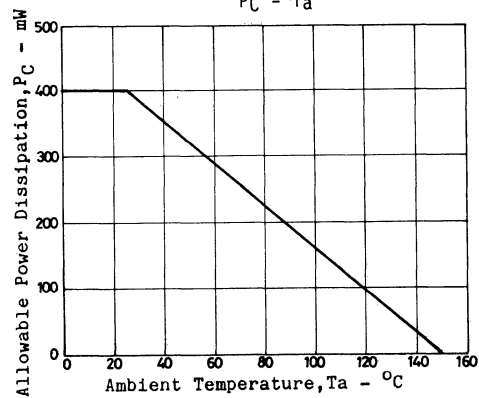
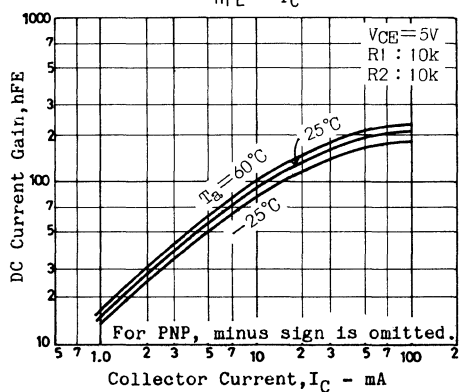
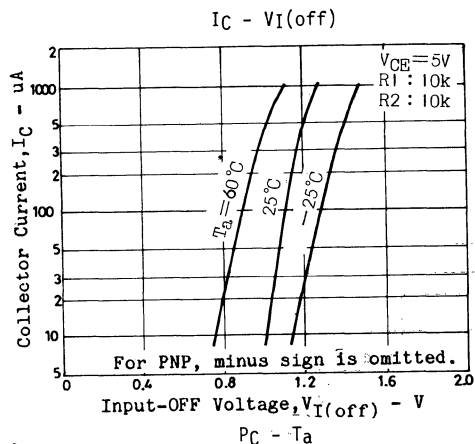
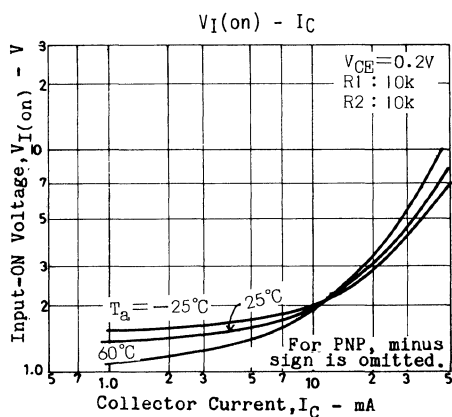
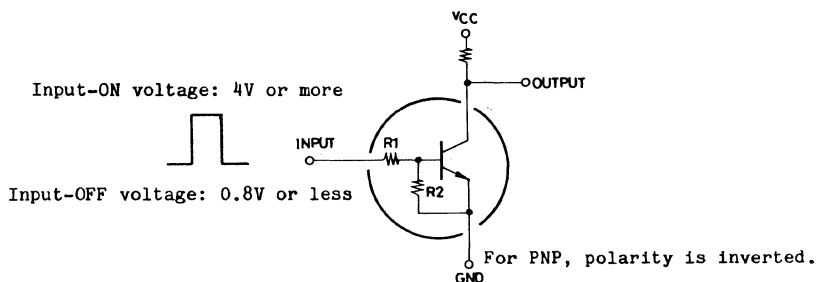
Case Outline 2003A (unit:mm)



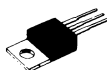
N284KI/TS No.1685-1/2

		min	typ	max	unit
Input-OFF Voltage	$V_{I(off)}$	$V_{CE}=(-)5V, I_C=(-)100\mu A$	$(-)0.8$	$(-)1.1$	$(-)1.5$ V
Input-ON Voltage	$V_{I(on)}$	$V_{CE}=(-)0.2V, I_C=(-)10mA$	-1.0	$(-)2.0$	$(-)4.0$ V
Input Resistance	R_1		7.0	10	13 kohm
Resistance Ratio	R_1/R_2		0.9	1.0	1.1 -

Sample Application Circuit



2SC3675



2010A

NPN Triple Diffused Planar
Silicon Transistor

High Voltage Amp, High Voltage Switching Applications

©1800

Applications

- . High-voltage amplifiers
- . High-voltage switching
- . Dynamic focus

Features

- . High breakdown voltage (V_{CEO} min=900V).
- . Small c_{ob} (c_{ob} typ=2.8pF).
- . Wide ASO (Adoption of MBIT process)
- . High reliability (Adoption of HVP process)

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

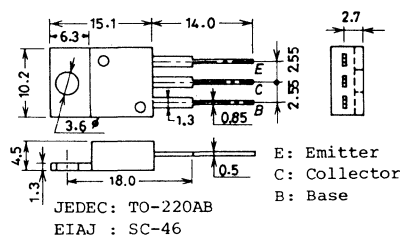
			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	900	V
Emitter to Base Voltage	V_{EBO}	5	V
Collector Current	I_C	100	mA
Peak Collector Current	i_{cp}	300	mA
Collector Dissipation	P_C	10	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

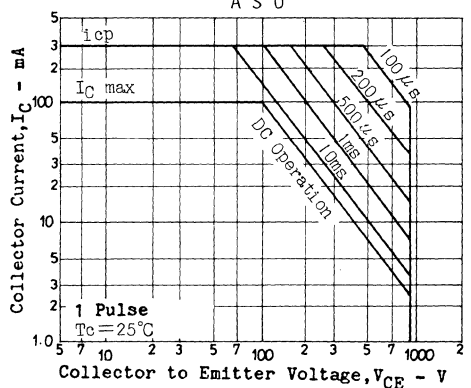
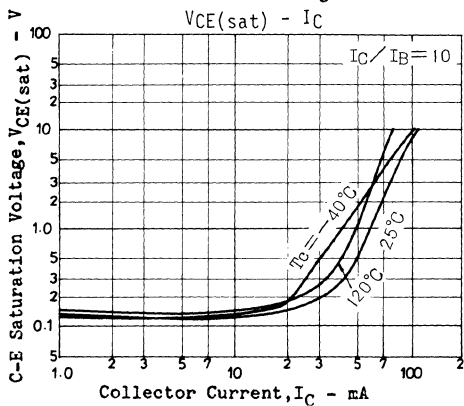
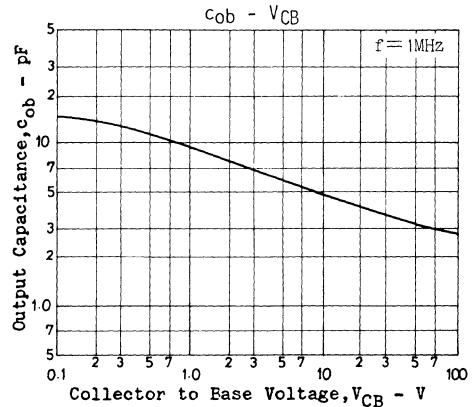
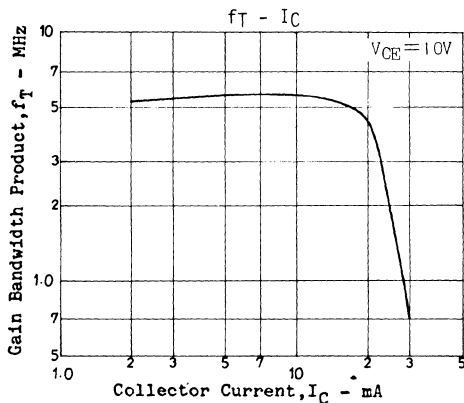
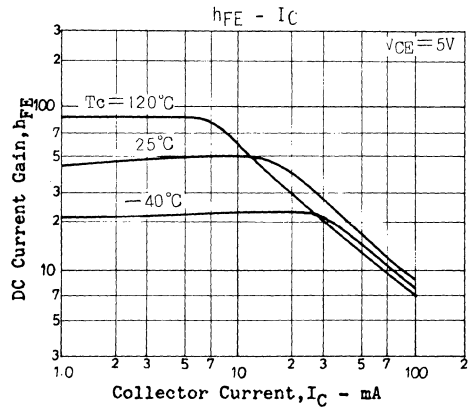
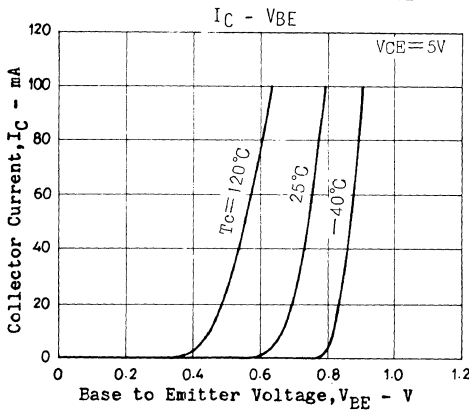
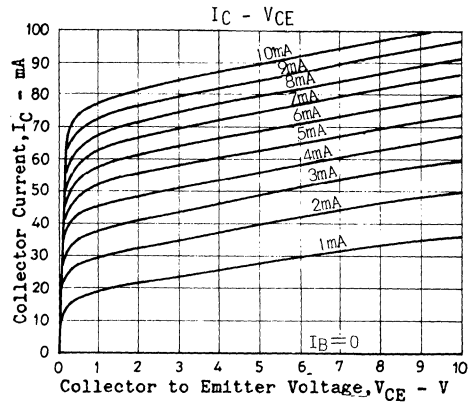
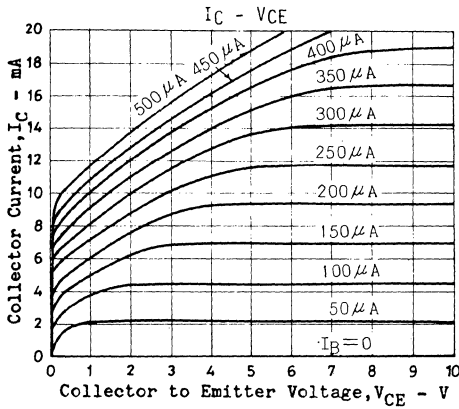
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=900\text{V}, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4\text{V}, I_C=0$			10	μA
DC Current Gain	h_{FE}	$V_{CE}=5\text{V}, I_C=10\text{mA}$	30			
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=10\text{mA}$		6		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=20\text{mA}, I_B=2\text{mA}$			2	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=20\text{mA}, I_E=2\text{mA}$			2	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1\text{mA}, I_E=0$	1000			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1\text{mA}, R_{BE}=\infty$	900			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1\text{mA}, I_C=0$	5			V
Output Capacitance	c_{ob}	$V_{CB}=100\text{V}, f=1\text{MHz}$		2.8		pF

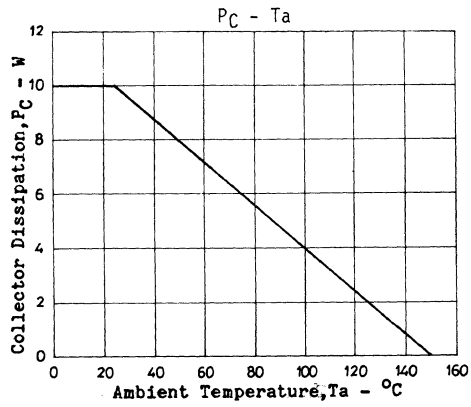
Case Outline 2010A

(unit:mm)

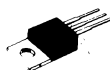


3195KI, TS No.1800-1/3





2SC3676



2010A

NPN Triple Diffused Planar
Silicon Transistor

High Voltage Amp, High Voltage Switching Applications

©1801

Applications

- High-voltage amplifiers
- High-voltage switching
- Dynamic focus

Features

- High breakdown voltage ($V_{CE0} \text{ min}=900\text{V}$).
- Small c_{ob} ($c_{ob} \text{ typ}=5.0\text{pF}$).
- Wide ASO (Adoption of MBIT process)
- High reliability (Adoption of HVP process)

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

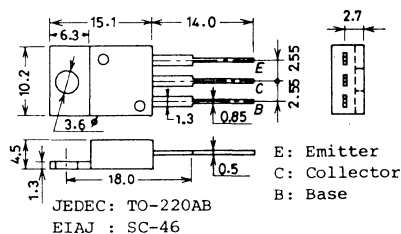
			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	900	V
Emitter to Base Voltage	V_{EBO}	5	V
Collector Current	I_C	300	mA
Peak Collector Current	i_{cp}	1	A
Collector Dissipation	P_C	20	W
Junction Temperature	T_J	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

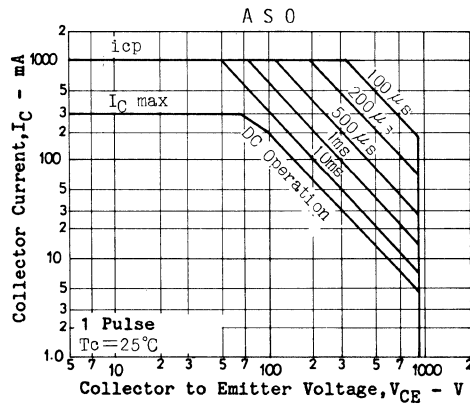
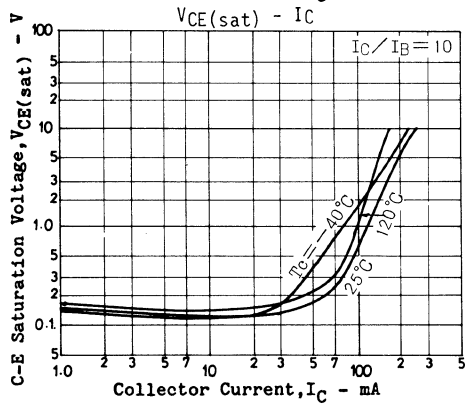
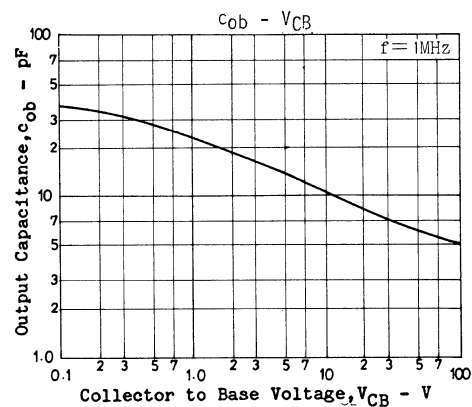
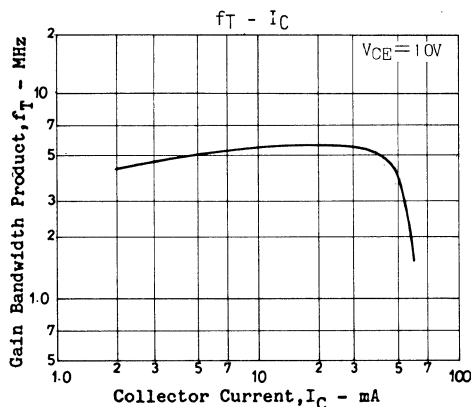
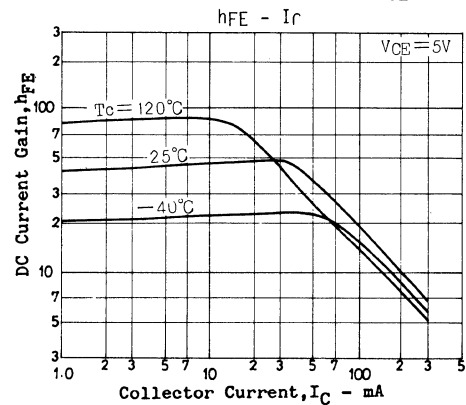
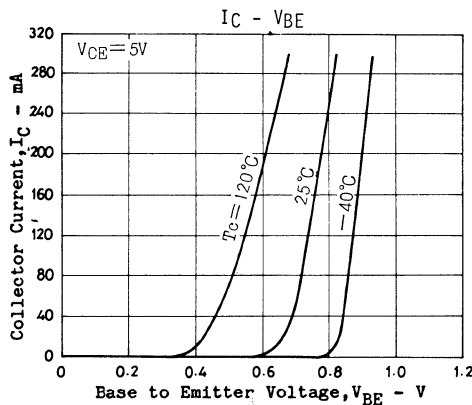
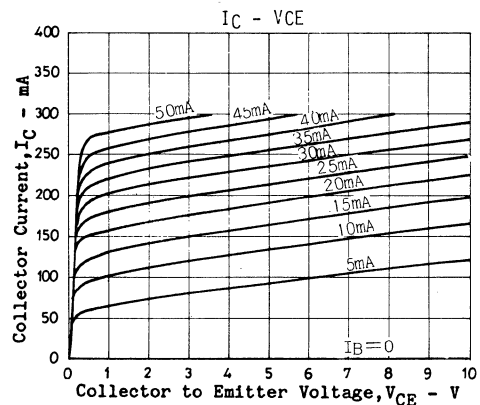
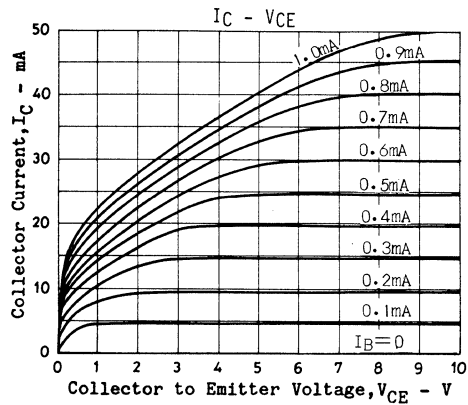
Electrical Characteristics at $T_a=25^\circ\text{C}$

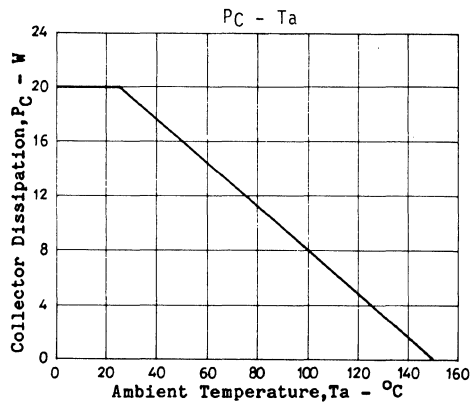
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=900\text{V}, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4\text{V}, I_C=0$			10	μA
DC Current Gain	h_{FE}	$V_{CE}=5\text{V}, I_C=30\text{mA}$	30			
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=30\text{mA}$		6		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=60\text{mA}, I_E=6\text{mA}$			2	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=60\text{mA}, I_E=6\text{mA}$			2	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=1\text{mA}, I_E=0$	1000			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1\text{mA}, R_{BE}=\infty$	900			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=1\text{mA}, I_C=0$	5			V
Output Capacitance	c_{ob}	$V_{CB}=100\text{V}, f=1\text{MHz}$		5.0		pF

Case Outline 2010A

(unit:mm)





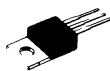


	Page		Page
2SD313.....	693	2SD1193.....	809
2SD314.....	693	2SD1194.....	812
2SD325.....	699	2SD1195.....	815
2SD330.....	702	2SD1196.....	818
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2SD386.....	705	2SD1207.....	822
2SD386A.....	705	2SD1212.....	825
2SD387.....	705	2SD1213.....	828
2SD387A.....	705	2SD1229.....	831
2SD400.....	707	2SD1230.....	834
2SD438.....	712	2SD1235.....	837
2SD439.....	715	2SD1236L.....	840
2SD545.....	719	2SD1237L.....	843
2SD600.....	723	2SD1238L.....	846
2SD600K.....	723	2SD1246.....	849
2SD612.....	726	2SD1247.....	852
2SD612K.....	726	2SD1347.....	855
2SD613.....	733	2SD1348.....	858
2SD734.....	736	2SD1394.....	861
2SD823.....	739	2SD1395.....	864
2SD826.....	741	2SD1396.....	867
2SD863.....	745	2SD1397.....	870
2SD879.....	748	2SD1398.....	873
2SD894.....	751	2SD1399.....	876
2SD895.....	753	2SD1400.....	879
2SD896.....	756	2SD1401.....	882
2SD1012.....	760	2SD1402.....	885
2SD1046.....	764	2SD1403.....	888
2SD1047.....	767	2SD1459.....	891
2SD1048.....	770	2SD1618.....	894
2SD1060.....	772	2SD1619.....	897
2SD1061.....	775	2SD1620.....	900
2SD1062.....	778	2SD1621.....	903
2SD1063.....	781	2SD1623.....	906
2SD1064.....	784	2SD1626.....	910
2SD1065.....	787	2SD1628.....	913
2SD1111.....	790	2SD1649.....	916
2SD1145.....	792	2SD1650.....	919
2SD1153.....	794	2SD1651.....	922
2SD1159.....	797	2SD1652.....	925
2SD1161.....	799	2SD1653.....	928
2SD1190.....	800	2SD1654.....	931
2SD1191.....	803	2SD1655.....	934
2SD1192.....	806	2SD1656.....	937

2SD-TYPE (LF NPN)

All specifications and characteristics shown on the following pages are for standard products. Data shown on individual figures, except P_C derating curve and ASO, are represented by typical values. Ambient temperature T_a is 25°C unless otherwise specified.

2SD313, 314



2010A



2012

NPN/PNP Triple Diffused Planar
Silicon Transistors

2SB507, 508

Low Frequency Power Amp Applications

©396D

- .2SB507,2SB508 and 2SD313,2SD314 are complementary pairs respectively.
- .These are designed for the output stage of 15W to 25W AF power amplifier.
- .2SB507 and 2SB508, or 2SD313 and 2SD314, differ from their care outlines only.
- () shows the case of 2SB507, 2SB508 only.

Absolute Maximum Ratings at Ta=25°C

Collector to Base Voltage	VCBO	(-)60	V
Collector to Emitter Voltage	VCEO	(-)60	V
Emitter to Base Voltage	VEBO	(-)5	V
Collector Current	IC	(-)3	A
	icp	(-)8	A
Collector Dissipation	PC	1.75	W
	(Tc=25°C)	30	W
Junction Temperature	Tj	150	°C
Storage Temperature	Tstg	-40 to +150	°C

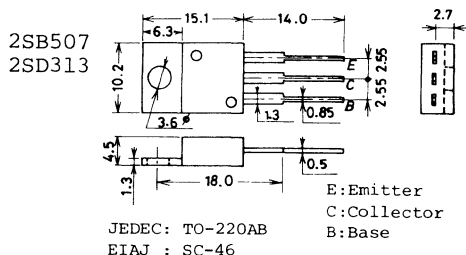
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cut Off Current	ICBO	V _{CB} =(-)20V, I _E =0			(-)0.1	mA
	ICEO	V _{CE} =(-)60V, R _{BE} =∞			(-)5	mA
Emitter Cut Off Current	IEBO	V _{EB} =(-)4V, I _C =0			(-)1	mA
	V _{S/B}	I _C =(-)0.5A, t=1sec	(-)60			V
DC Current Gain	*h _{FE} (1)	V _{CE} =(-)2V, I _C =(-)1A	40*		320*	
	h _{FE} (2)	V _{CE} =(-)2V, I _C =(-)0.1A	40			
Gain Band Width Product	f _T	V _{CE} =(-)5V, I _C =(-)0.5A		8		MHz
Output Capacitance	cob	V _{CB} =(-)10V, 2SB507,508		(130)		pF
		f=1MHz 2SD313,314		65		pF
C-E Saturation Voltage	V _{CE} (sat)	I _C =(-)2A, I _B =(-)0.2A	(-)0.4	(-)1.0		V
Base to Emitter Voltage	V _{BE}	I _C =(-)1A, V _{CE} =(-)2V		(-)1.5		V

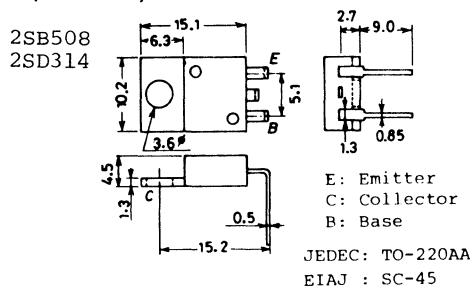
* 2SB507,508/2SD313,314 are classified by (-)1A h_{FE} as follows:

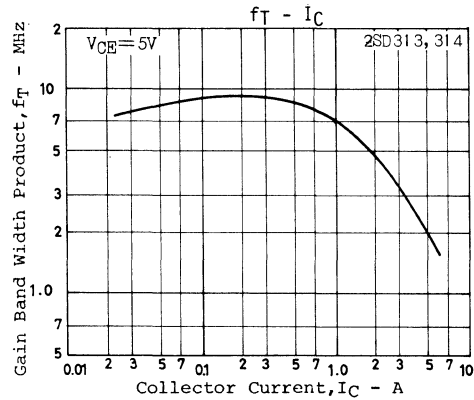
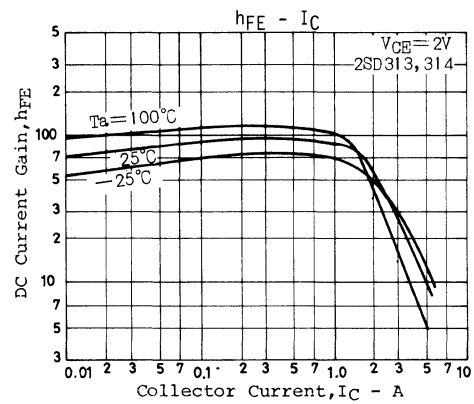
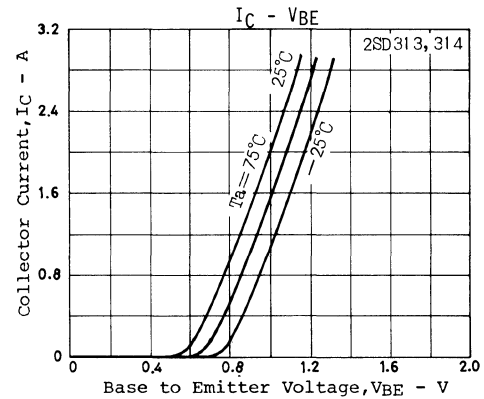
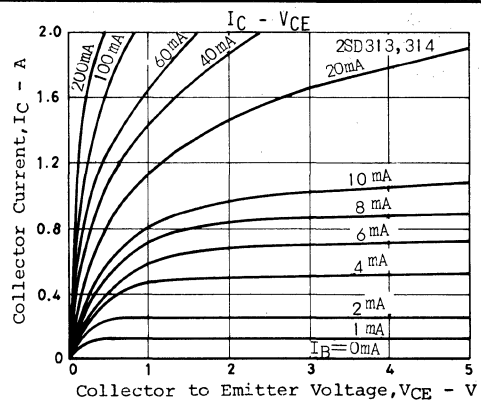
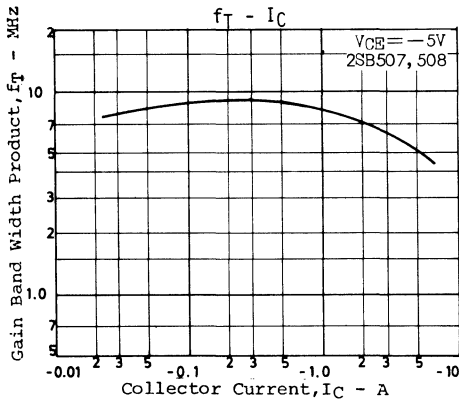
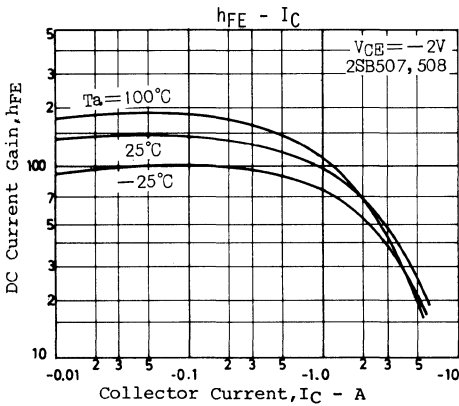
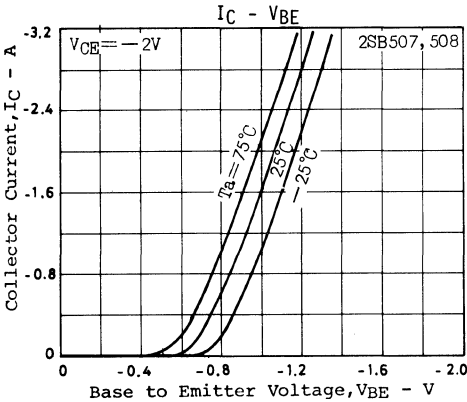
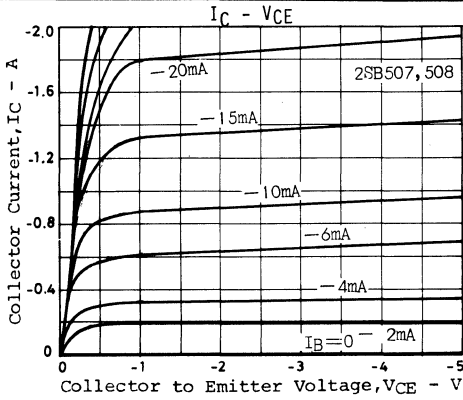
40	C	80	60	D	120	100	E	200	160	F	320
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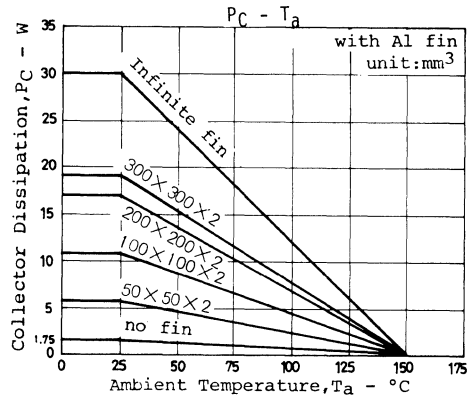
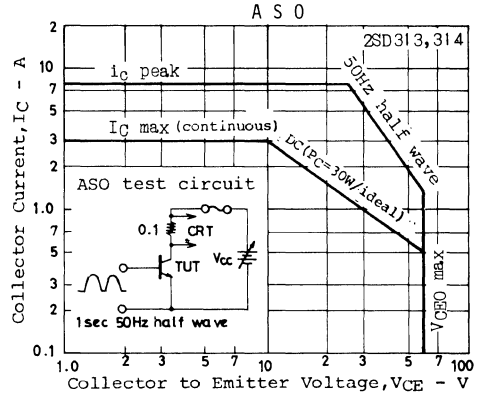
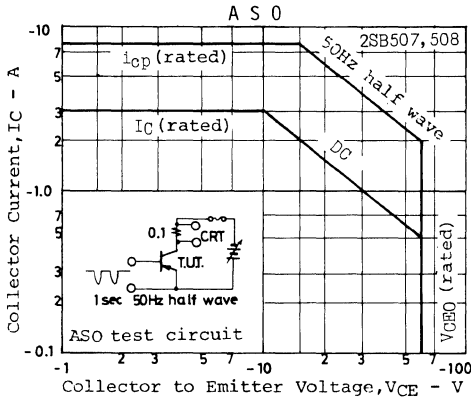
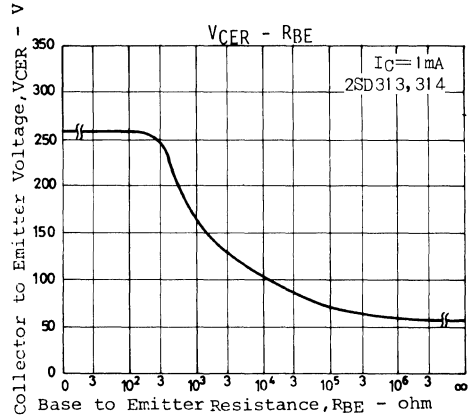
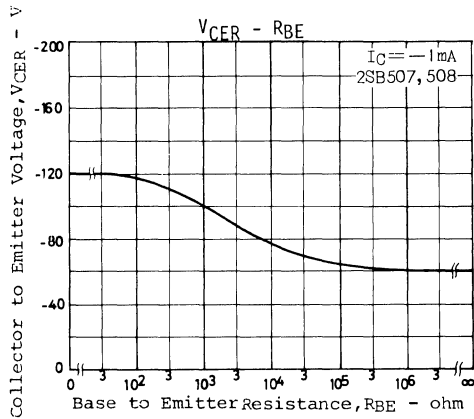
Case Outline 2010A
(unit:mm)



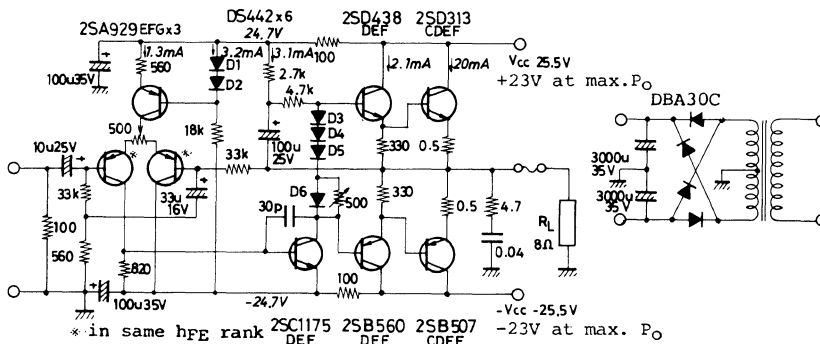
Case Outline 2012
(unit:mm)







Application 1 20W Pure Complementary PP AF Power Amplifier Using 2SB507 /2SD313



Recommended Operation Condition at $T_a=25^\circ\text{C}$

Supply Voltage	V_{CC}	± 25.5	V
Load Resistance	R_L	8	ohm

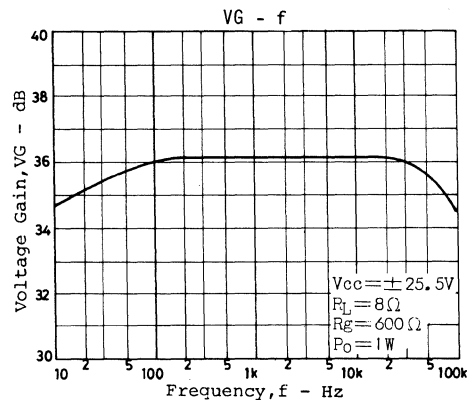
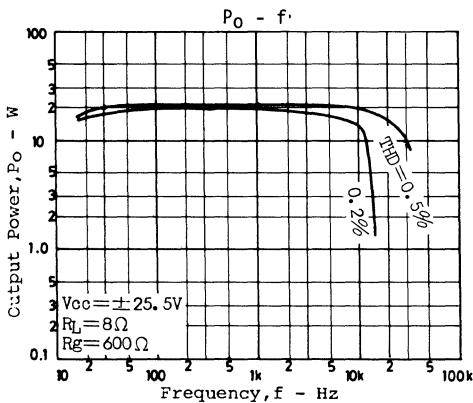
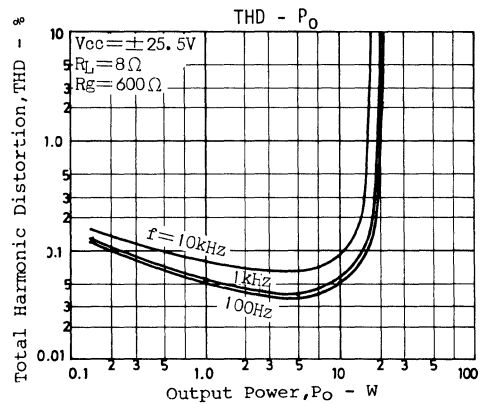
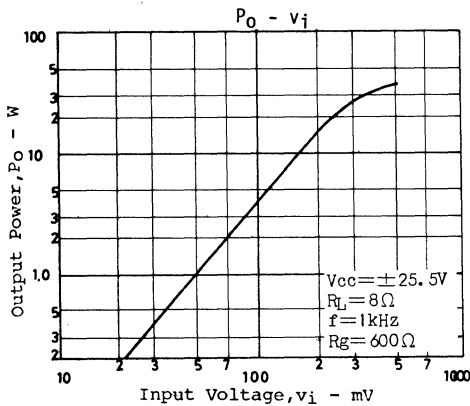
Operation Characteristics at $T_a=25^\circ\text{C}$, $R_L=8\text{ohm}$, $f=1\text{kHz}$, $V_{CC}=\pm 25.5\text{V}$ (at no signal), $\pm 23\text{V}$ (at max P_O).

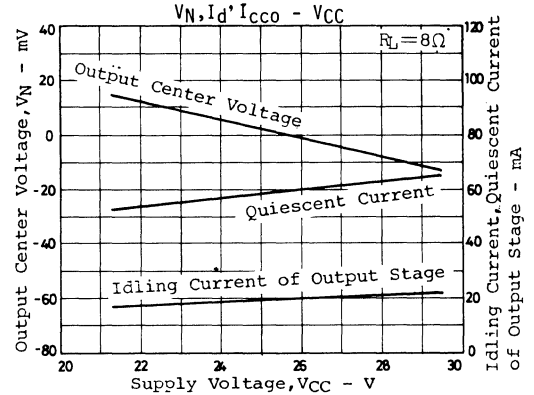
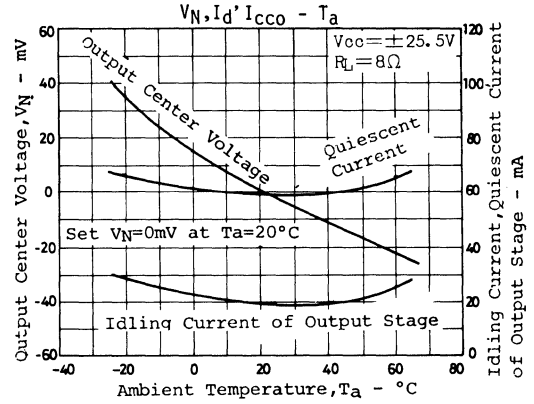
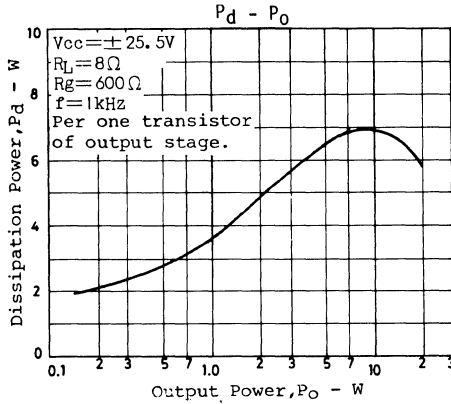
Quiescent Current	I_{CCO}	29.7	mA
Output Power	P_{Omax}	20	W
Voltage Gain	VG	36	dB
Total Harmonic Distortion	THD	0.08	%
Input Impedance	r_i	100	kohm
Output Impedance	r_o	0.16	ohm
Power Band Width	PBW	20 to 20k	Hz
Output Noise Voltage	V_{NO}	0.3	mV
Output Center Voltage	V_N	0 ± 30	mV

(Under the condition of AC 100V, transformer driven.)

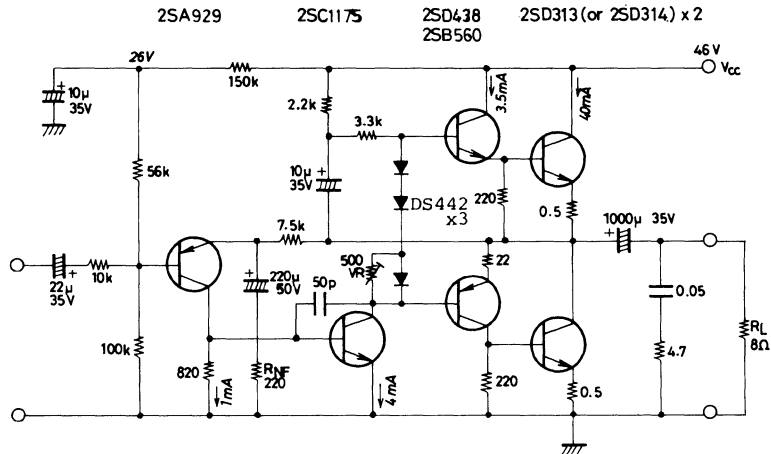
Circuit Configuration

Differential amplifier for first stage. Voltage regulator for rejecting of click noise at switching-on time. Darlington output stage of 2SB507/2SD313. High input impedance of 100 kohm by bootstrap circuit. This input impedance can be varied varying this input resistor. In order to suppress oscillation, 30pF between base and collector, and 4.7ohm/0.04uF in parallel with R_L of output are available. Nevertheless frequency response is -2dB at 100kHz. In emitter of differential amplifier of first stage 500 ohm variable resistor makes output center voltage to zero whatever hpf rank used.



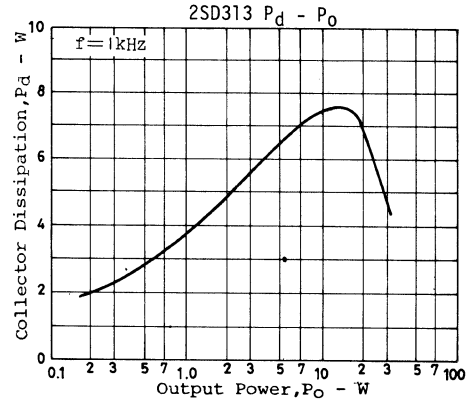
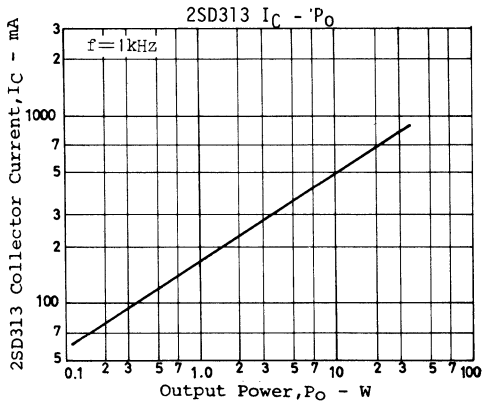
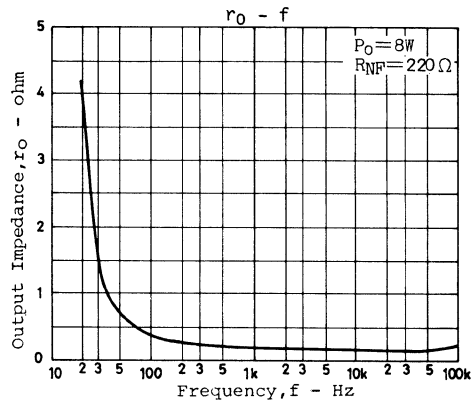
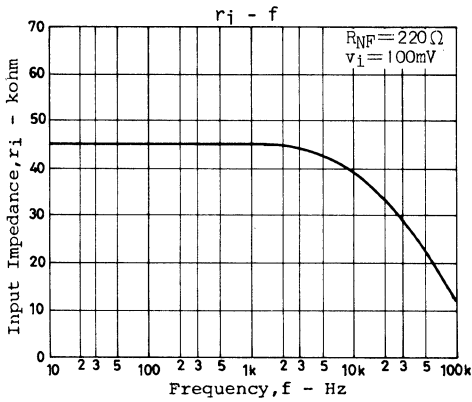
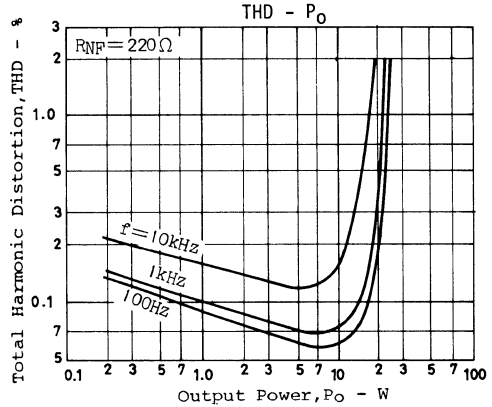
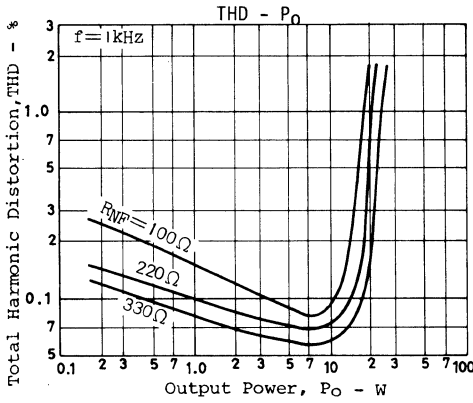
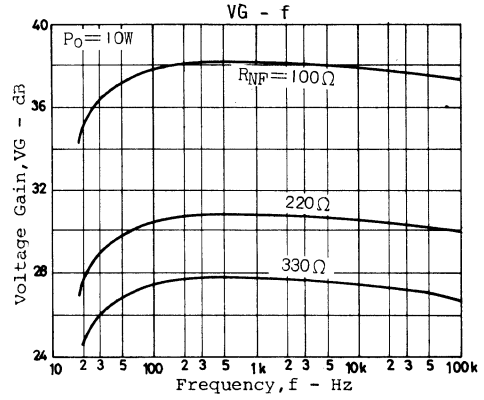
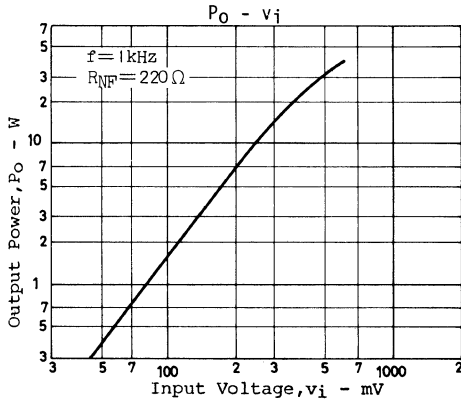


Application 2 20W AF Power Amplifier Using 2SD313(2SD314)x2.

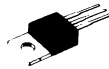


Main Characteristics

Operating Temperature	Topg	Operates at $P_O = 8W, T_a = 25$ to $60^\circ C$	
Load Shorting Test	t_s	Perfect at V_{CC} 10% up, 10 seconds shorted.	
Supply Voltage	V_{CC}	50	V
Load Resistance	R_L	8	ohm
Maximum Output Power	P_O	THD=0.5%	20 W
Voltage Gain	VG	$P_C = 10W$	30.8 dB
Total Harmonic Distortion	THD	$P_O = 1W$	0.1 %
Input Impedance	r_i	$v_i = 100mV$	45k ohm
Output Impedance	r_o	$P_O = 8W$	0.2 ohm
Quiescent Current	I_{CCO}		40 mA



2SD325



2010A

NPN/PNP Triple Diffused Planar
Silicon Transistors**2SB511**

Low Frequency Power Amp Applications

©398E

. 5 Watts AF Power amplifier output use. There are complementary pair.

():2SB511

Absolute Maximum Ratings at Ta=25°C

Collector to Base Voltage	V _{CB0}	(-) 35	V	
Collector to Emitter Voltage	V _{CE0}	(-) 35	V	
Emitter to Base Voltage	V _{EB0}	(-) 5	V	
Collector Current	I _C	(-) 1.5	V	
Peak Collector Current	i _{cp}	(-) 3	A	
Collector Dissipation	P _C	1.75	W	
		T _C =25°C	10	W
Junction Temperature	T _j	150	°C	
Storage Temperature	T _{stg}	-40 to +150	°C	

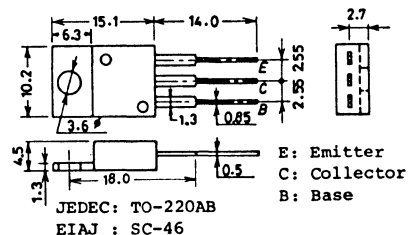
Electrical Characteristics at Ta=25°C

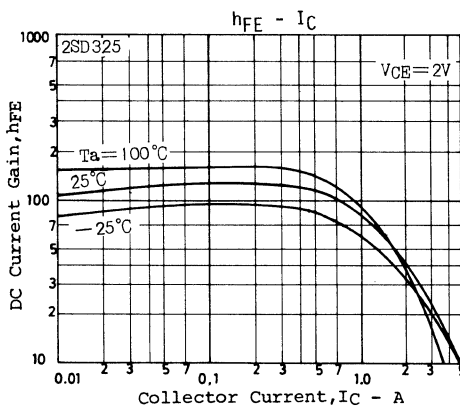
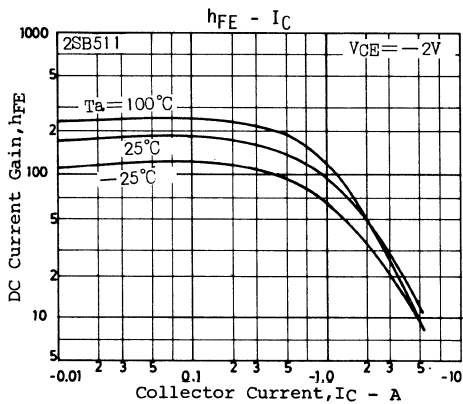
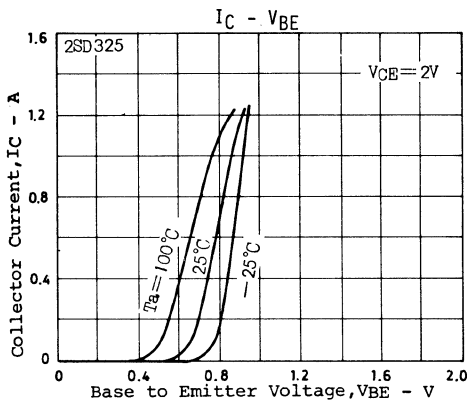
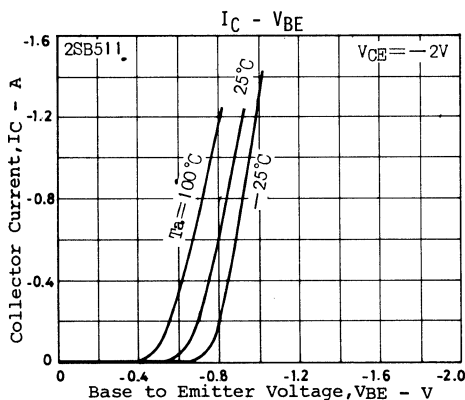
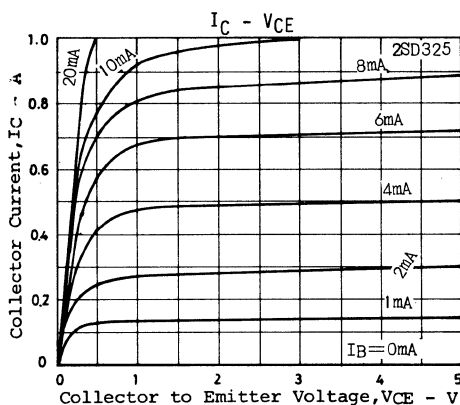
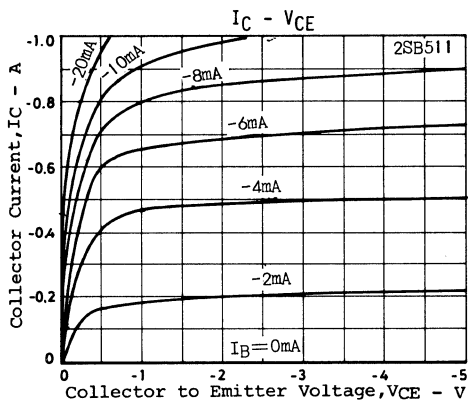
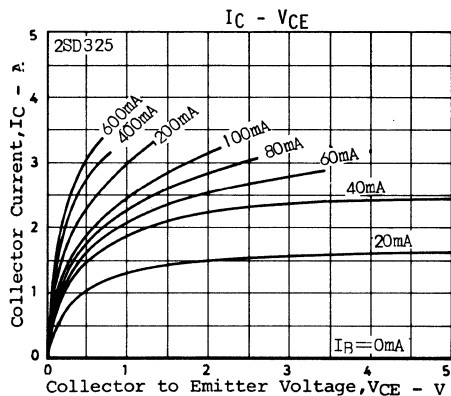
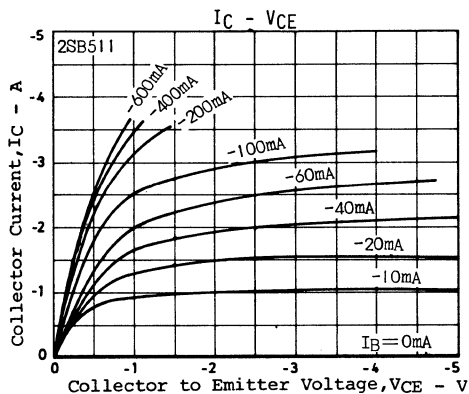
		min	typ	max	unit
Collector Cutoff Current	I _{CBO} V _{CB} =(-) 20V, I _E =0		(-) 0.1		mA
Emitter Cutoff Current	I _{EBO} V _{EB} =(-) 4V, I _C =0		(-) 1.0		mA
DC Current Gain	h _{FE} (1) *V _{CE} =(-) 2V, I _C =(-) 1A	40*		320*	
	h _{FE} (2) V _{CE} =(-) 2V, I _C =(-) 0.1A	35			
Gain Bandwidth Product	f _T V _{CE} =(-) 5V, I _C =(-) 0.5A		8		MHz
C-E Saturation Voltage	V _{CE} (sat) I _C =(-) 1.5A, I _B =(-) 0.15A		(-) 1.0		V
Base to Emitter Voltage	V _{BE} I _C =(-) 1A, V _{CE} =(-) 5V		(-) 1.5		V

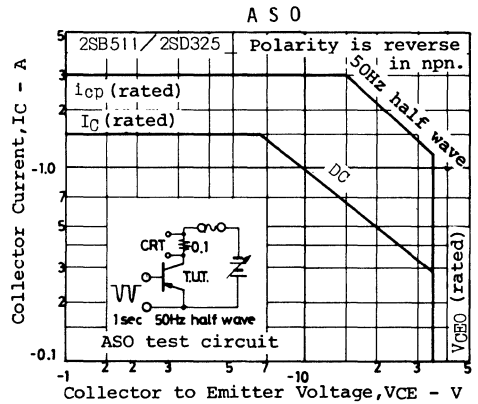
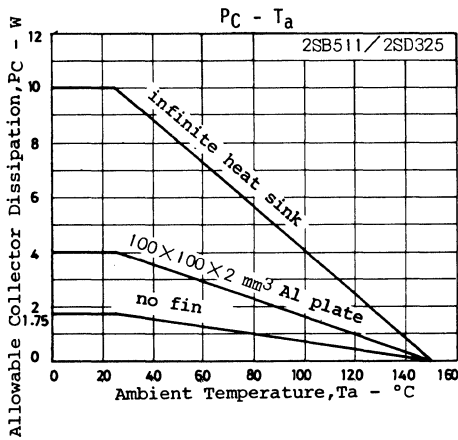
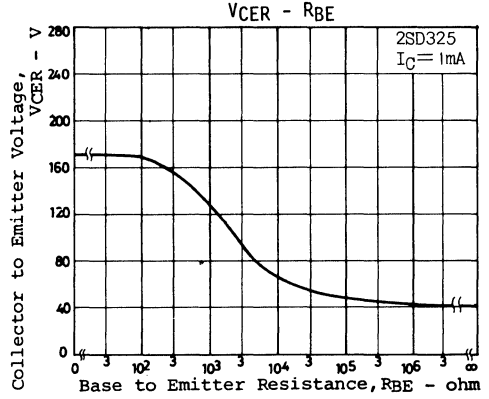
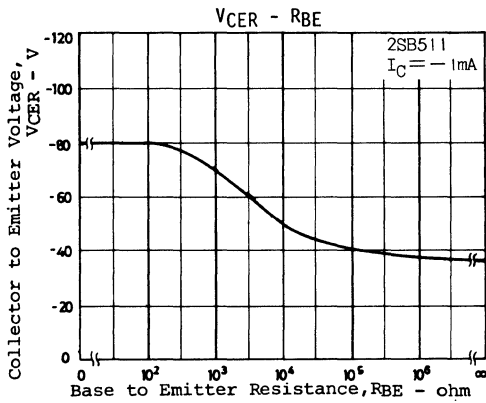
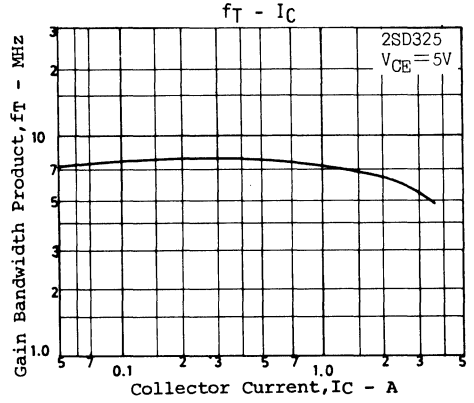
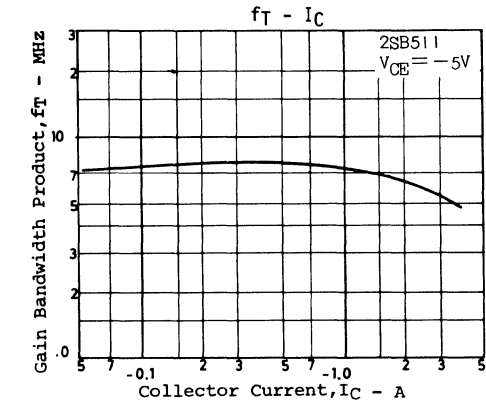
* Classified by 2V 1A h_{FE} as follows :

40	C	80	60	D	120	100	E	200	160	F	320
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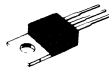
Case Outline 2010A (unit:mm)







2SD330, 331



2010A



2012

NPN/PNP Triple Diffused Planar
Silicon Transistors

2SB514, 515

Low Frequency Power Amp Applications

©997B

. Especially suited for use in output stage of 10W AF Power amp. The only difference between B514 and D515 lies in package design; and the same is true of D330 and D331. The B514 and D330 can be connected to form a complementary pair; and the same is true of B515 and D331.

():2SB514,514.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	VCBO	(-)50	V
Collector to Emitter Voltage	VCEO	(-)50	V
Emitter to Base Voltage	VEBO	(-)5	V
Collector Current	IC	(-)2	A
Peak Collector Current	icp	(-)5	A
Collector Dissipation	PC	1.75	W
	($T_c=25^\circ\text{C}$)	20	W
Junction Temperature	Tj	150	$^\circ\text{C}$
Storage Temperature	Tstg	-40 to +150	$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

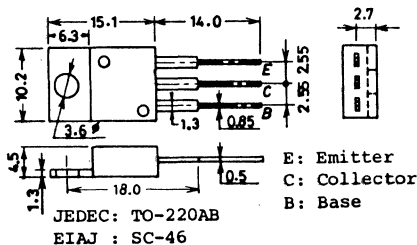
			min	typ	max	unit
Collector Cutoff Current	ICBO	$V_{CB}=(-)20\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	IEBO	$V_{EB}=(-)4\text{V}, I_C=0$			(-)1.0	mA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)2\text{V}, I_C=(-)1\text{A}$	40*		320*	
	$h_{FE}(2)$	$V_{CE}=(-)2\text{V}, I_C=(-)0.1\text{A}$	35			
Gain Bandwidth Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)0.5\text{A}$		8		MHz
C-E Saturation Voltage	$V_{CE}(\text{sat})$	$I_C=(-)2\text{A}, I_B=(-)0.2\text{A}$		(-)1.0		V
Base to Emitter Voltage	V_{BE}	$I_C=(-)1\text{A}, V_{CE}=(-)5\text{V}$		(-)1.5		V

* Classified by 2V 1A h_{FE} as follows :

40	C	80	60	D	120	100	E	200	160	F	320
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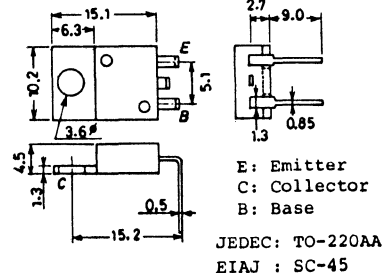
Case Outline 2010A

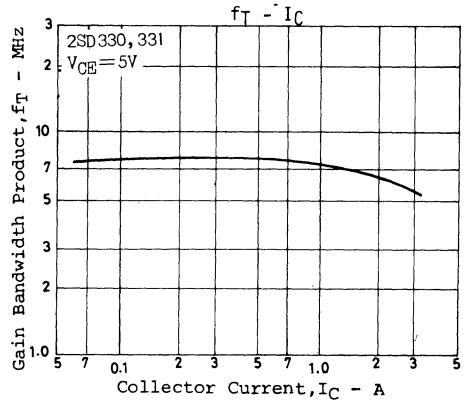
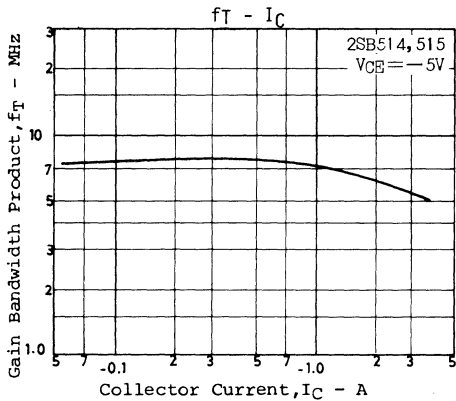
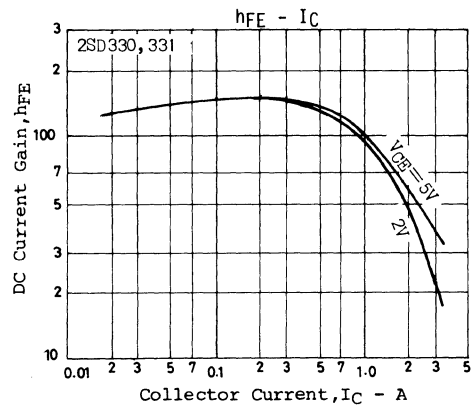
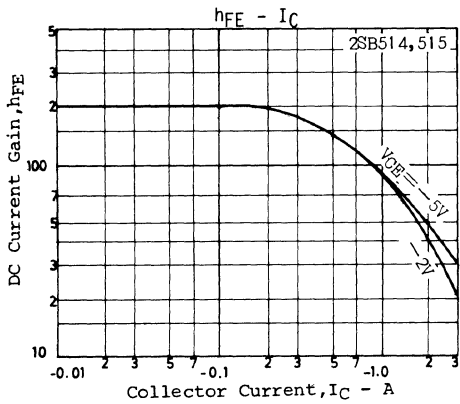
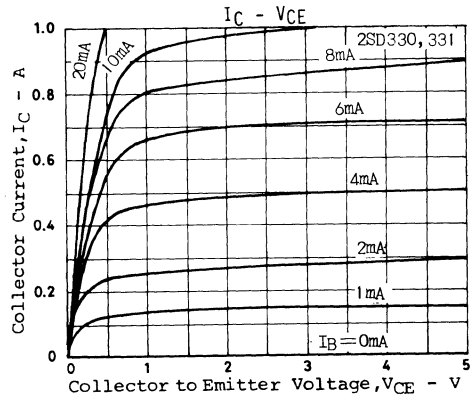
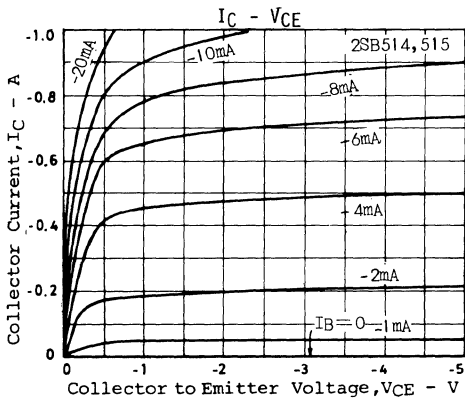
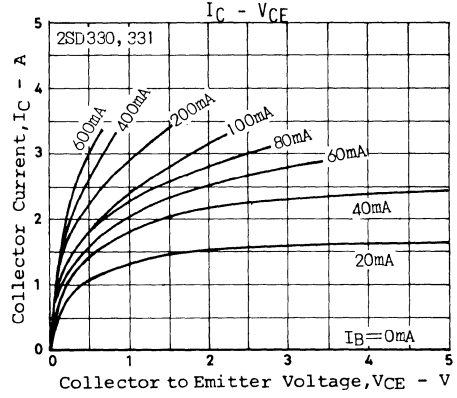
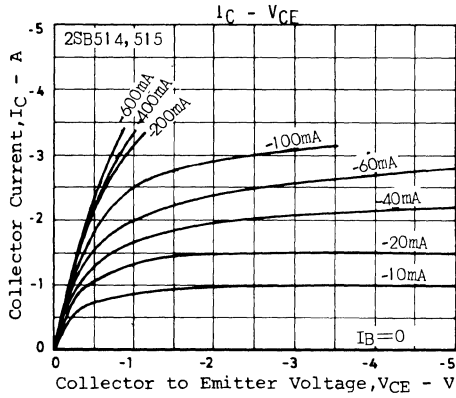
(unit:mm) [2SB514/2SD330]

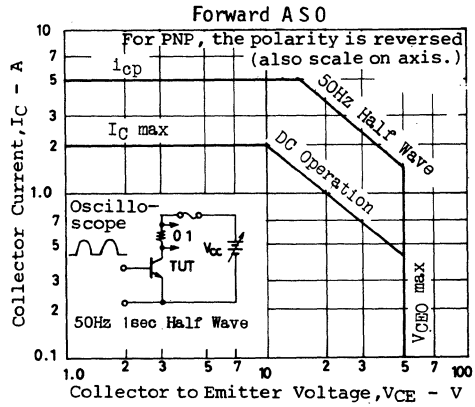
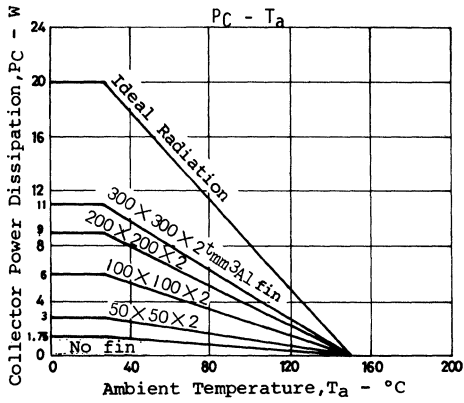


Case Outline 2012

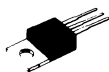
(unit:mm) [2SB515/2SD331]







2SD386,A, 387,A



2010A



2012

NPN Triple Diffused Planar
Silicon Transistors

TV Vertical Output Applications

©424C

Absolute Maximum Ratings at Ta=25°C

	2SD386	2SD386A	2SD387	2SD387A	unit
Collector to Base Voltage, V_{CB0}	200	200	200	200	V
Collector to Emitter Voltage, V_{CE0}	120	150	120	150	V
Emitter to Base Voltage, V_{EB0}	6	6	6	6	V
Collector Current, I_C	3	2	3	2	A
Peak Collector Current, i_{CP}	10	10	10	10	A
Collector Dissipation, P_C	($T_C=25^\circ\text{C}$) 25	25	25	25	W
	($T_a=25^\circ\text{C}$) 1.75	1.75	1.75	1.75	W
Junction Temperature, T_j	150	150	150	150	$^\circ\text{C}$
Storage Temperature, T_{stg}	→	→	→ -40	+150	$^\circ\text{C}$

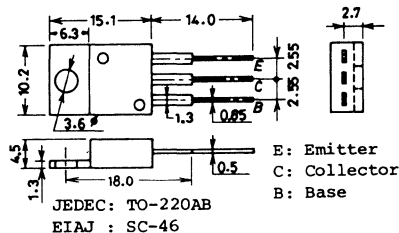
Electrical Characteristics at Ta=25°C

		min	typ	max	unit
Collector Cutoff Current, I_{CB0}	$V_{CB}=180\text{V}, I_E=0$			1.0	mA
Emitter Cutoff Current, I_{EB0}	$V_{EB}=5\text{V}, I_C=0$			5	mA
DC Current Gain, h_{FE}^*	$V_{CE}=2\text{V}, I_C=0.5\text{A}$	40*		320*	
Gain Bandwidth Product, f_T	$V_{CE}=5\text{V}, I_C=0.5\text{A}$		8		MHz
C-E Saturation Voltage, $V_{CE(sat)}$	$I_C=1\text{A}, I_B=0.1\text{A}$	2SD386, 387		1.0	V
		2SD386A, 387A		1.5	V
B-E Saturation Voltage, $V_{BE(sat)}$	$I_C=1\text{A}, I_B=0.1\text{A}$	2SD386, 387		1.8	V
		2SD386A, 387A			

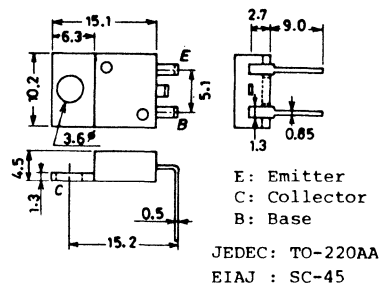
* The 2SD386, 386A, 387, 387A are classified as follows by h_{FE} at 0.5A.

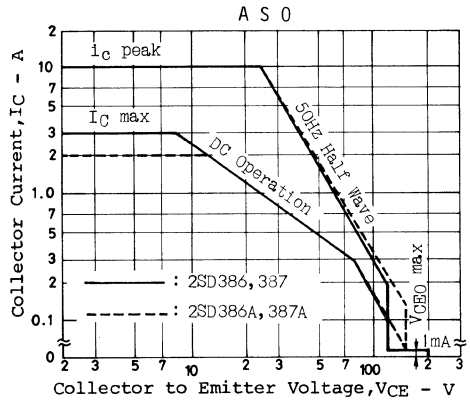
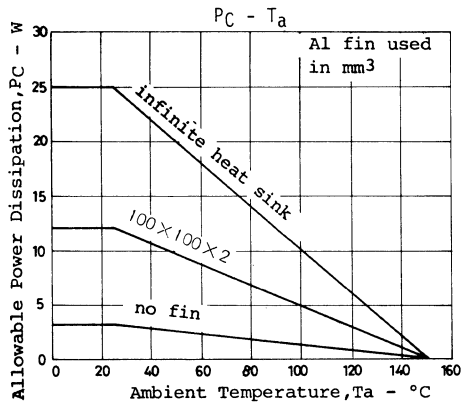
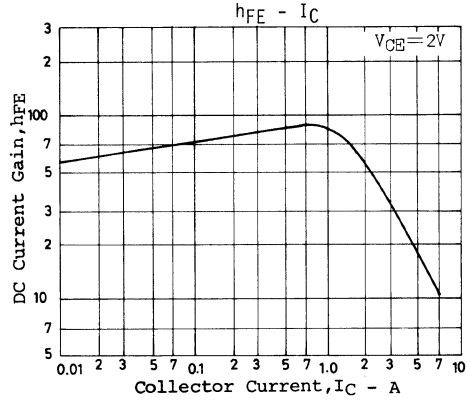
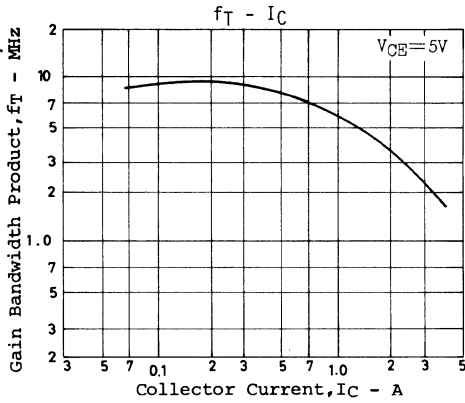
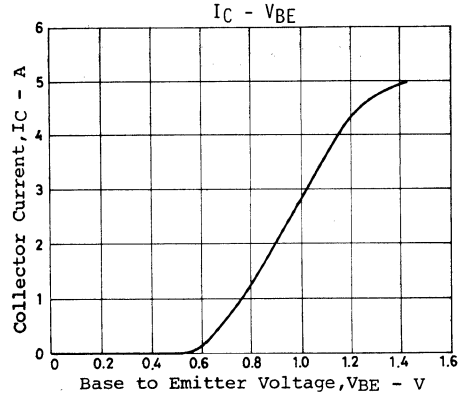
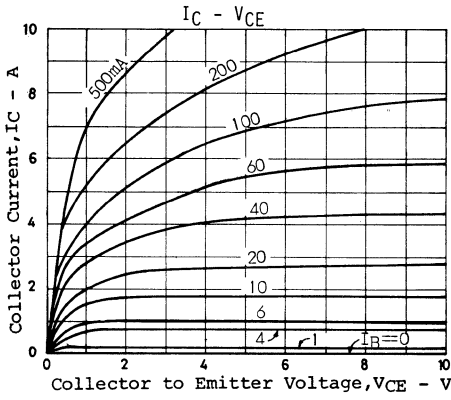
40	C	80	60	D	120	100	E	200	160	F	320
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Case Outline 2010A (unit:mm)



Case Outline 2012 (unit:mm)







2006A

NPN/PNP Epitaxial Planar Silicon Transistors

2SB544

Low Frequency Power Amp, Electronic Governor Applications

©199H

(): 2SB544

Absolute Maximum Ratings at Ta=25°C

Absolute Maximum Ratings at Ta=25°C			unit
Collector to Base Voltage	V _{CBO}	(-)25	V
Collector to Emitter Voltage	V _{CEO}	(-)25	V
Emitter to Base Voltage	V _{EBO}	(-)5	V
Collector Current	I _C	(-)1	A
Peak Collector Current	i _{cp}	(-)2	A
Collector Dissipation	P _C	900	mW
Junction Temperature	T _j	150	°C
Storage Temperature	T _{stg}	-55 to +150	°C

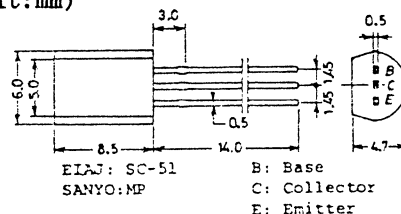
Electrical Characteristics at Ta=25°C

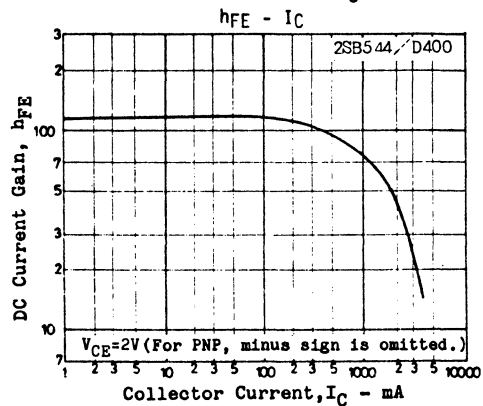
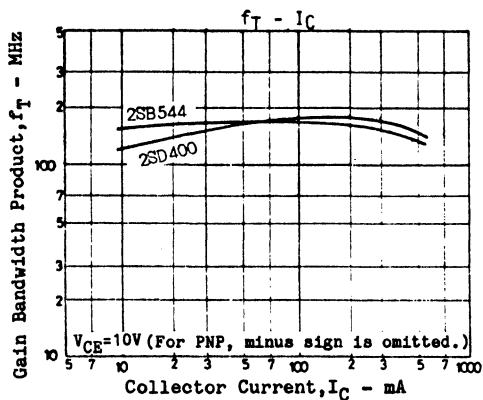
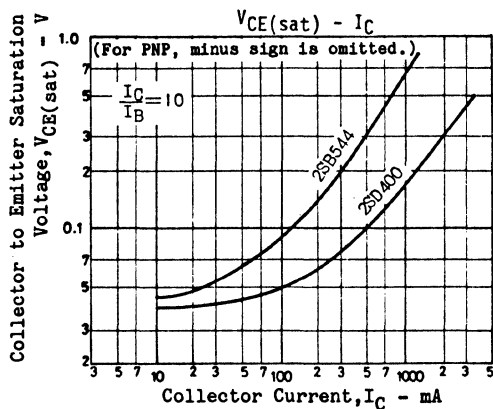
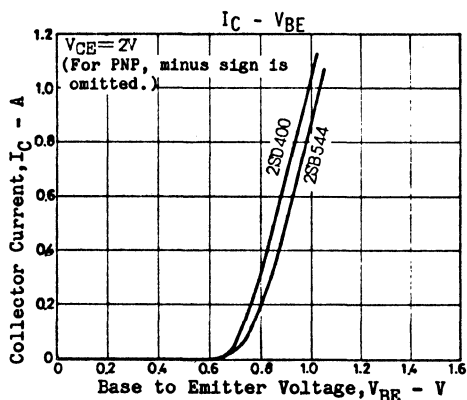
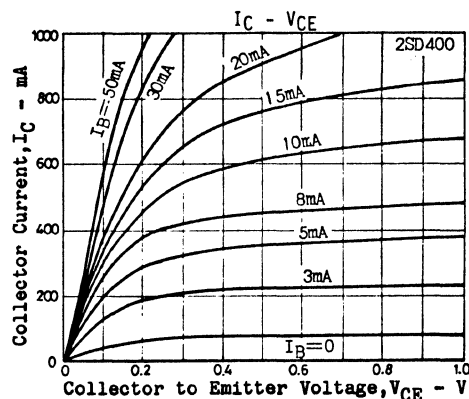
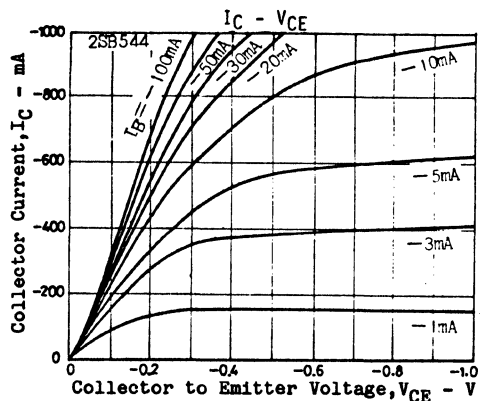
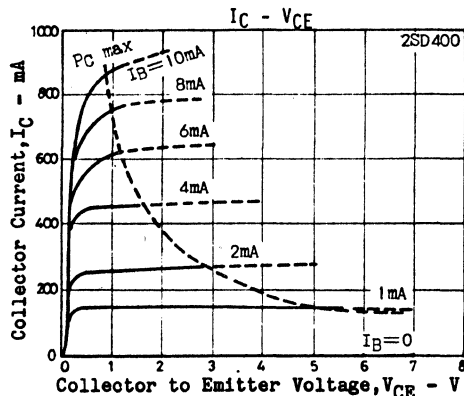
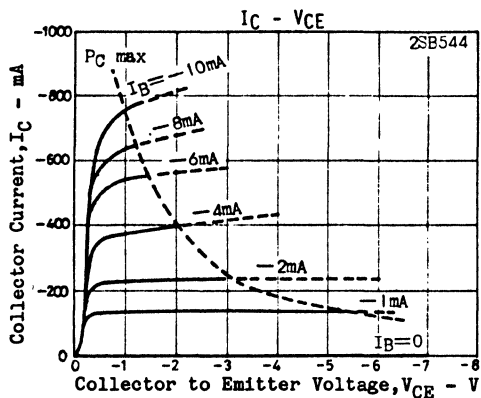
Electrical Characteristics at Ta=25°C		min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)20V, I_E=0$		(-) 1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$		(-) 1.0	μA
DC Current Gain	$h_{FE(1)}$	$V_{CE}=(-)2V, I_C=(-)50mA$	60		560
	$h_{FE(2)}$	$V_{CE}=(-)2V, I_C=(-)1A$	30		
		Pulse Test			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$	180		MHz
			(25)		
Output Capacitance	c_{ob}	$V_{CB}=(-)10V, f=1MHz$	15		pF
			(-0.15)	(-0.7)	
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500mA, I_B=(-)50mA$	0.1	0.3	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500mA, I_B=(-)50mA$	(-) 0.85	(-) 1.2	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu A, I_E=0$	(-) 25		V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	(-) 25		V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu A, I_C=0$	(-) 5		V

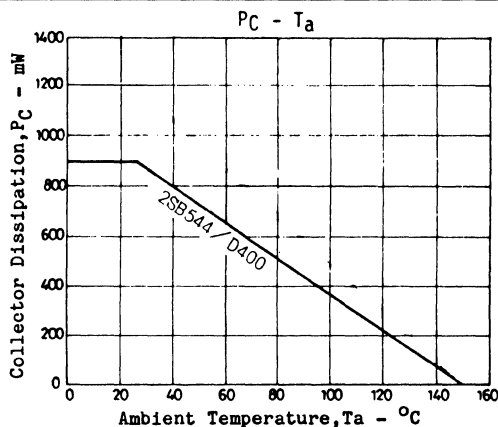
* The 2SB544/2SD400 are classified by 50mA h_{FE} as follows:

60	D	120	100	E	200	160	F	320	280	G	560
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Case Outline 2006A
(unit:mm)

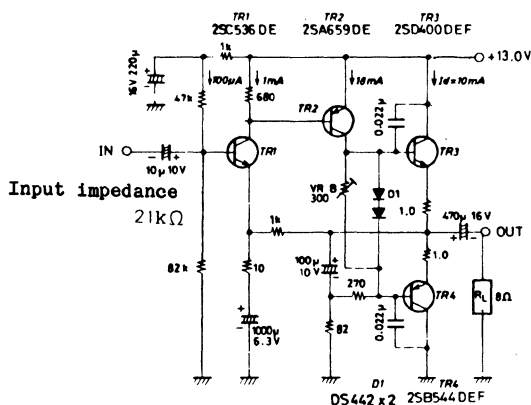




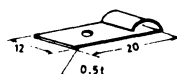


Supply Voltage	V_{CC}	13.0	V
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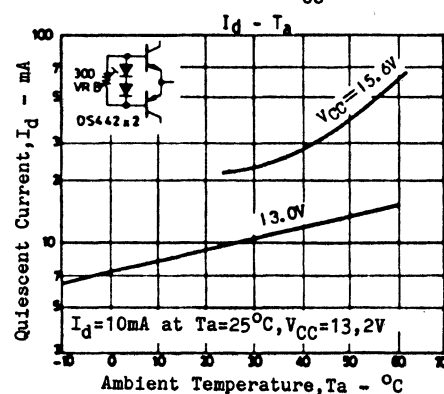
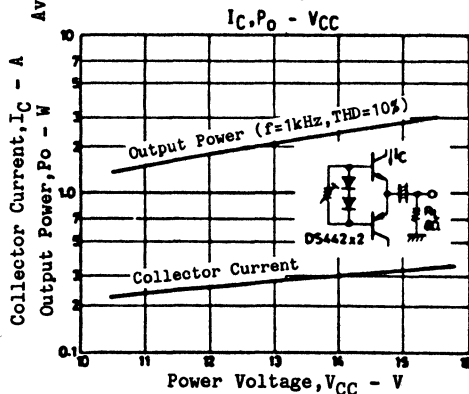
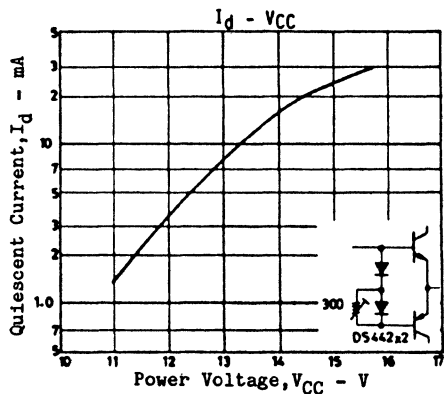
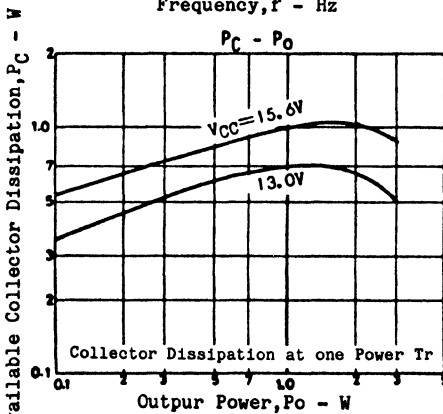
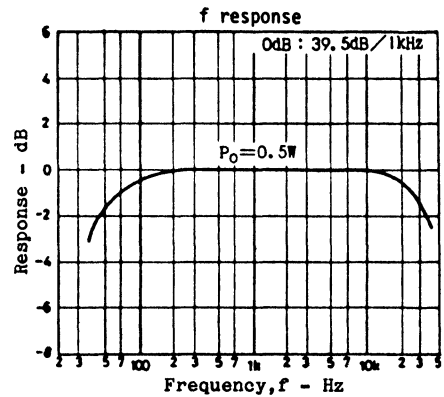
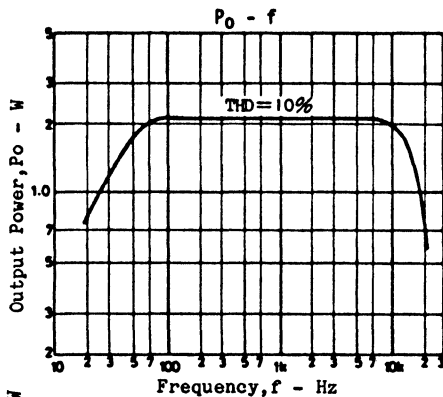
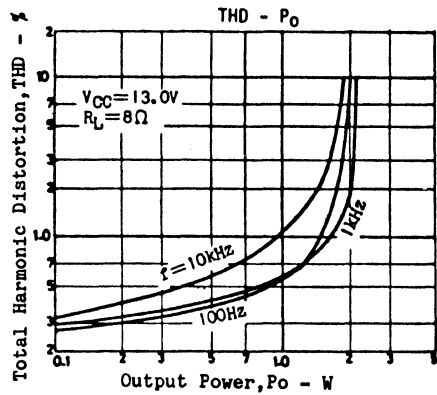
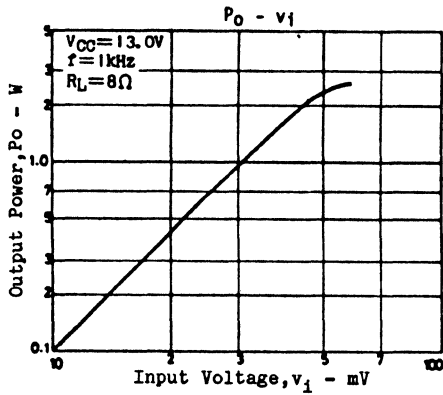
Quiescent Current	I_{CC0}	Power stage	10	mA
Total Current Eissipation	I_{CC}	Quiescent	30	mA
Maximum Output Power	P_o	THD=10%	2.1	W
Voltage Gain	VG		39.5	dB
Total Harmonic Distortion	THD	$P_o=0.5W$	0.42	%
Frequency Response	f	$P_o=0.5W, -3dB$	36 to 43k	Hz
Input Impedance	r_i		21k	ohm
Output Impedance	r_o		0.7	ohm
Supply Voltage at which	V_{CC}		9.2	V
Cross-over Distortion comes out				
Guaranteed Ambient Temperature Range			-10 to 60	$^{\circ}C$
Available Supply Voltage Range			13.0 $\pm$ 20%	V

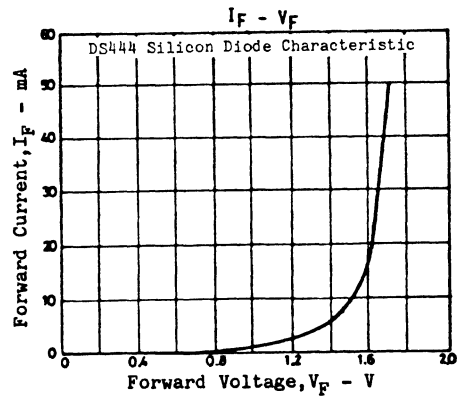
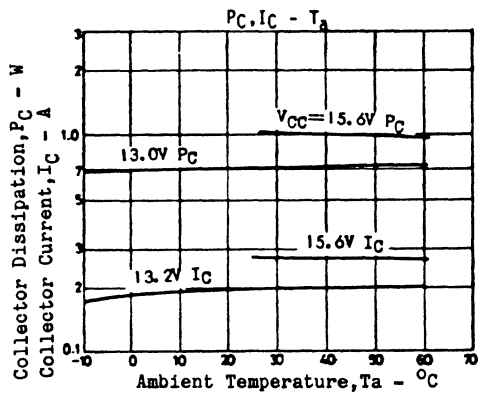


Heat sink
In this example, the following jig
is attached to an Al plate of
70x65x2mm (for 2 transistors).



unit:mm





2SD438



2006A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB560

Low Frequency Power Amp Applications

©326F

The 2SB560/2SD438 are epitaxial planar transistors for complementary push-pull pair having high reverse voltage and low saturation voltage, and suitable universal AF power amplifier use.

():2SB560

Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CBO}	(-)100	V
Collector to Emitter Voltage	V_{CEO}	(-)80	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)0.7	A
Peak Collector Current	i_{cp}	(-)1.0	A
Collector Dissipation	P_C	900	mW
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

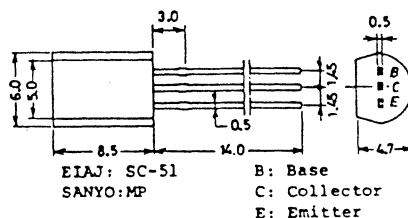
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)20V, I_E=0$			(-)1.0	uA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$			(-)1.0	uA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=(-)5V, I_C=(-)50mA$	*60		*560	
	$h_{FE}(2)$	$V_{CE}=(-)5V, I_C=(-)0.5A$	30			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		100		MHz
Output Capacitance	c_{ob}	$V_{CE}=(-)10V, f=1MHz$		(15)		pF
				10		pF
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10uA$	(-)100			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, R_{BE}=\infty$	(-)80			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_C=(-)10uA, I_E=0$	(-)5			V
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500mA, I_B=(-)50mA$	(-0.3)	(-0.8)		V
			0.2	0.6		V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500mA, I_B=(-)50mA$	(-)0.85	(-)1.2		V

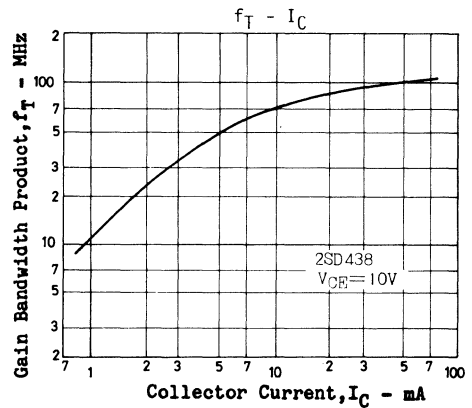
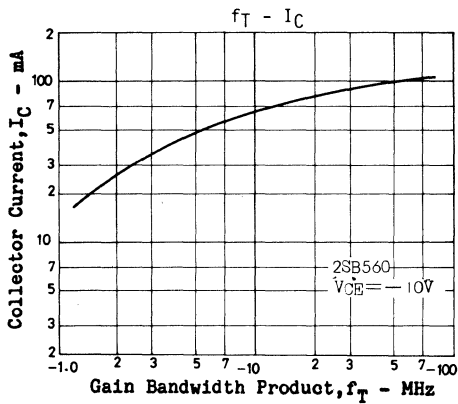
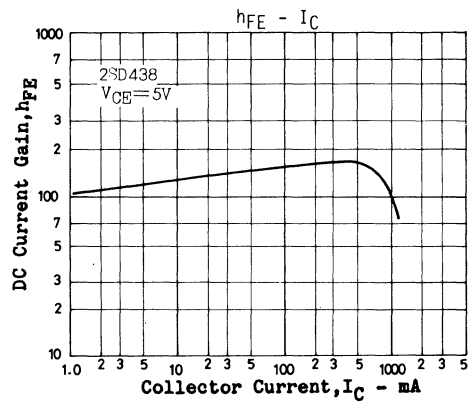
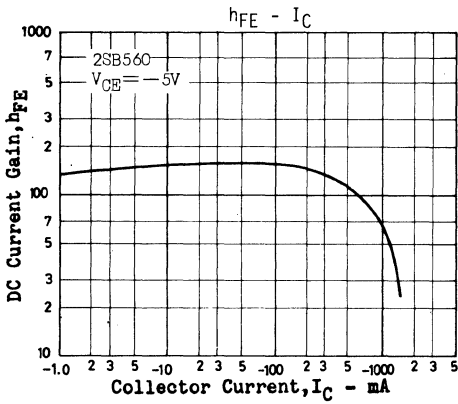
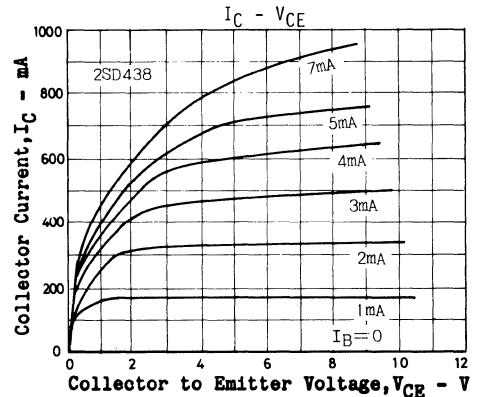
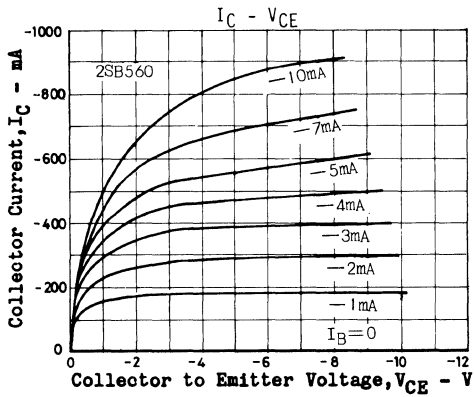
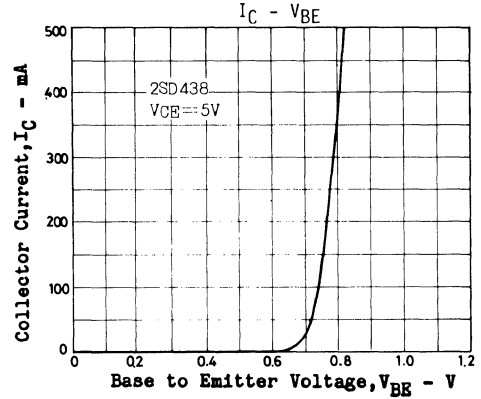
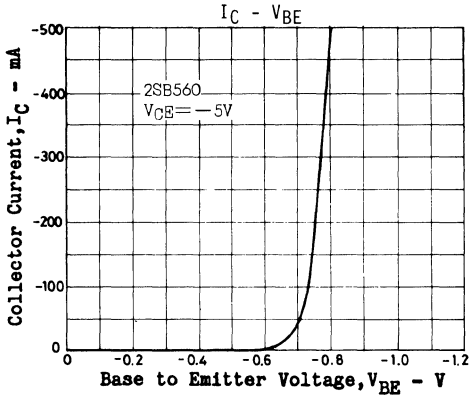
* The 2SB560/2SD438 are classified by (-)50mA h_{FE} as follows.

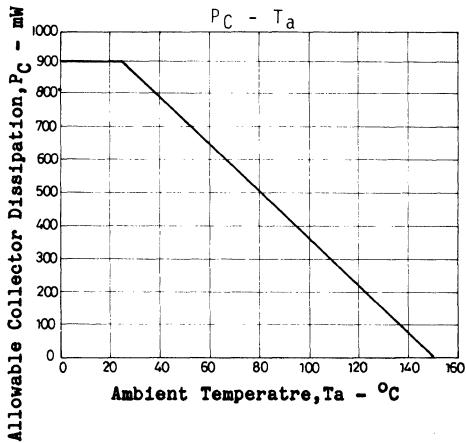
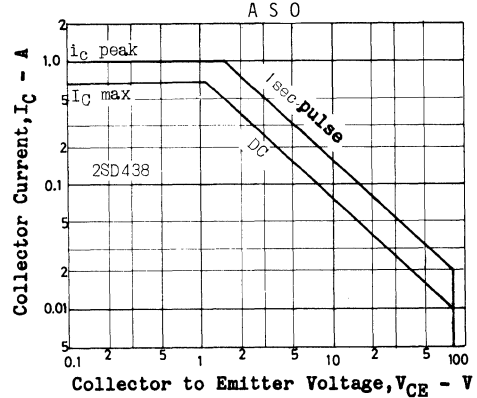
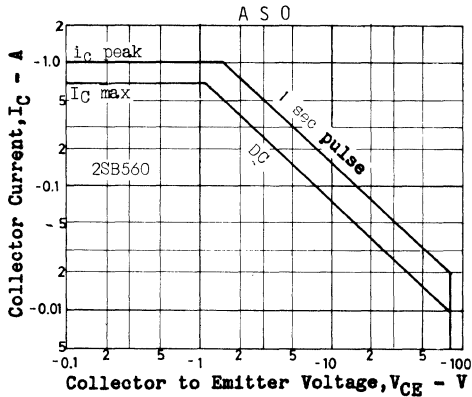
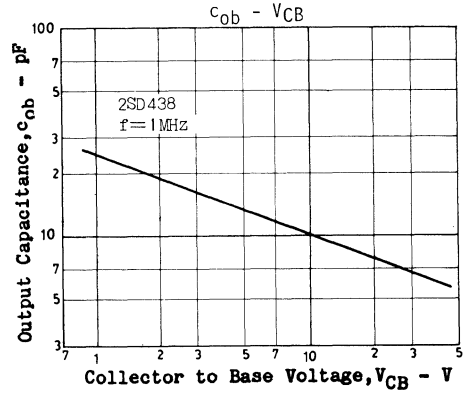
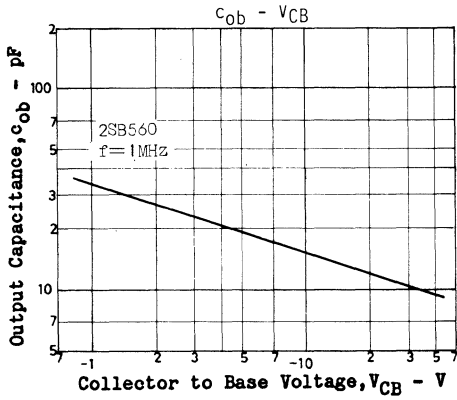
60	D	120	100	E	200	160	F	320	280	G	560
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Case Outline 2006A (unit:mm)



3085MY, TS No.326-1/3





2SD439



2009

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB559

Low Frequency Power Amp, Medium Speed Switching Applications

Ⓔ372D

Features

- . Large allowable collector dissipation and wide ASO.
- . Low saturation voltage and good linearity of h_{FE} .
- . Suited for use in output stage of low-voltage high-output ($P_o=2W/V_{CC}=4.5V$) AF amp.

():2SB559

Absolute Maximum Ratings at $T_a=25^{\circ}C$

Absolute Maximum Ratings at Ta=25°C				unit
Collector to Base Voltage	V _{CB0}	(-)20	V	
Collector to Emitter Voltage	V _{CE0}	(-)18	V	
Emitter to Base Voltage	V _{EB0}	(-)5	V	
Collector Current	I _C	(-)1.2	A	
Peak Collector Current	i _{cp}	(-)2.0	A	
Collector Dissipation	P _C	1	W	
		Tc=25°C	8	W
Junction Temperature	Tj	150	°C	
Storage Temperature	Tstg	-55 to +150	°C	

Electrical Characteristics at $T_a=25^{\circ}C$

			min	typ	max	unit
C-B Breakdown Voltage	$V_{(BR)CB0}$	$I_C=(-)10uA, I_E=0$	(-)20			V
C-E Breakdown Voltage	$V_{(BR)CE0}$	$I_C=(-)1mA, R_{BE}=\infty$	(-)18			V
E-B Breakdown Voltage	$V_{(BR)EB0}$	$I_E=(-)10uA, I_C=0$	(-)5			V
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)15V, I_E=0$			(-)1	uA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)4V, I_C=0$			(-)1	uA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)2V, I_C=(-)500mA$	60*		320*	
	$h_{FE}(2)^*$	$V_{CE}=(-)2V, I_C=(-)1.5A$	(40)50			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		150		MHz
Collector Capacitance	c_{ob}	$V_{CB}=(-)10V, f=1MHz$	(30)20			pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)1A, I_B=(-)50mA$	(-0.35)	(-0.7)		V
			0.25	0.5		V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500mA, I_B=(-)50mA$	(-)0.85	(-)1.2		V
Turn-ON Time	t_{on}	At specified Test Circuit		50		ns
Storage Time	t_{stg}	"		(60)70		ns
Fall Time	t_f	"		200		ns

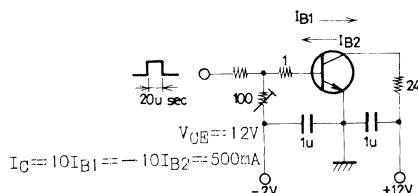
* The 2SB559/2SD439 are classified by h_{FE} at 500mA.

60	D	120	100	E	200	160	F	320
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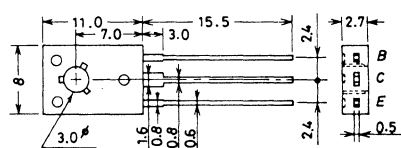
Case Outline 2009

(unit:mm)

Switching Time Test Circuit

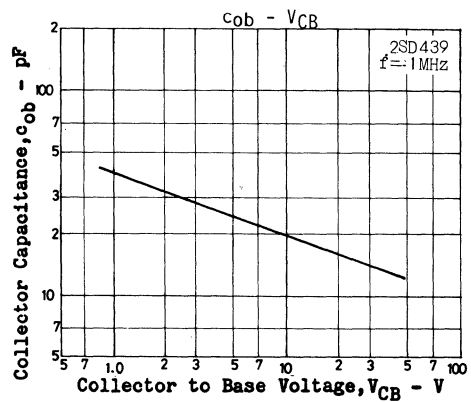
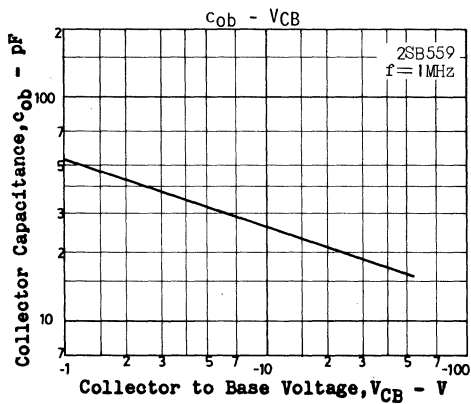
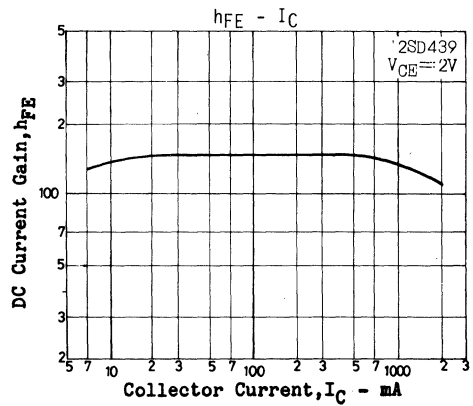
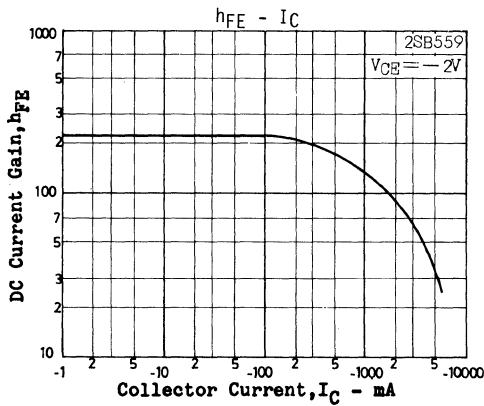
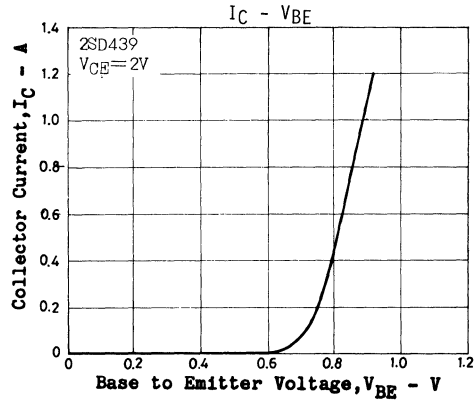
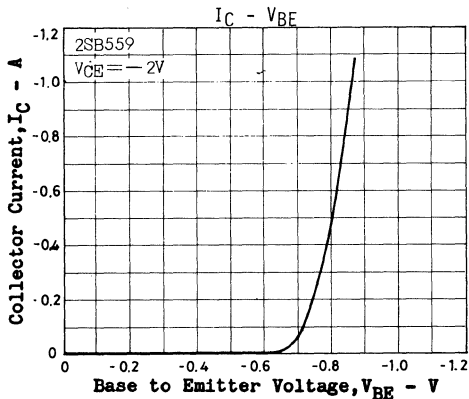
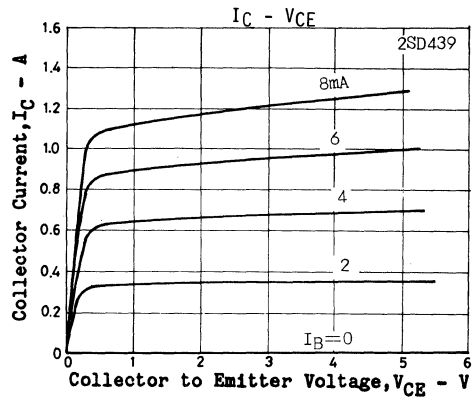
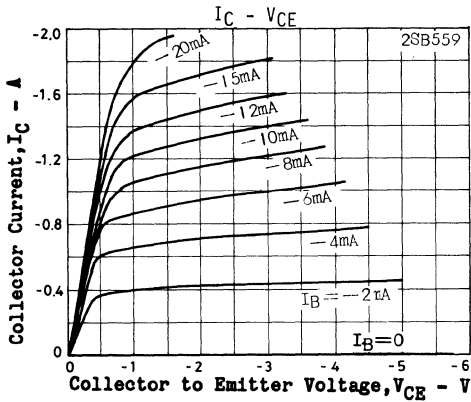


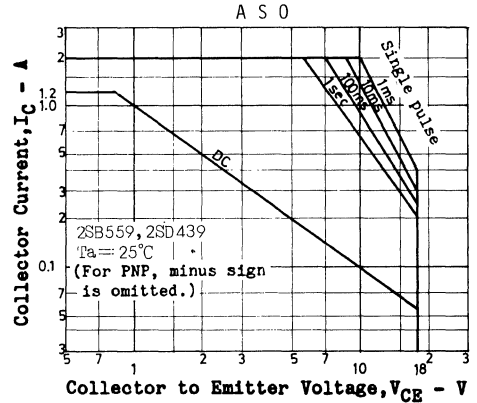
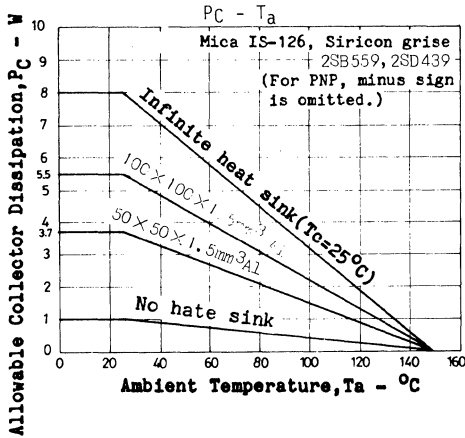
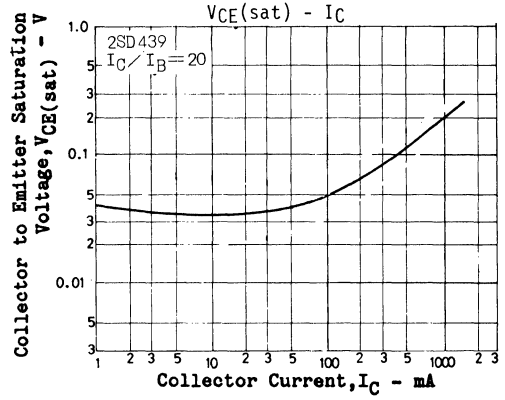
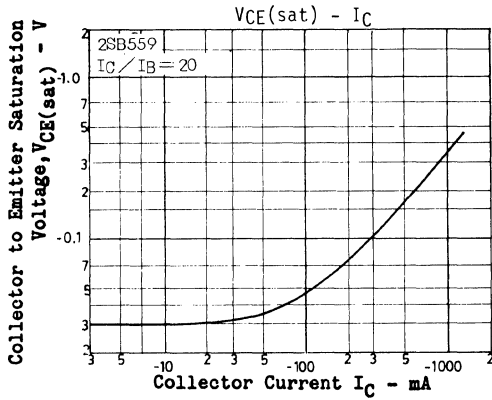
(For PNP, polarity is reversed)



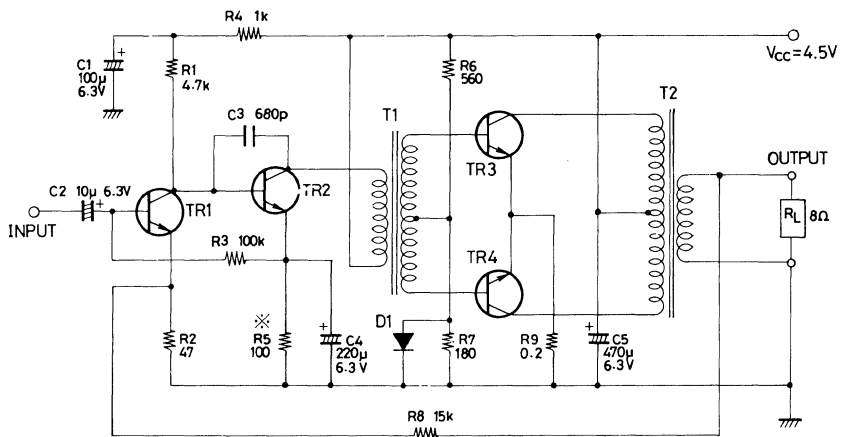
JEDEC: TO-126

B: Base
C: Collector
E: Emitter





Sample Application Circuit: 2SD439-used 2.2W input/output transformer coupling amp



TR1: 2SC536 E.F TR2: 2SC536 E.F D1: DS442 TR3: 2SD439 E1, E2, F1, F2
TR4: 2SD439 E1, E2, F1, F2

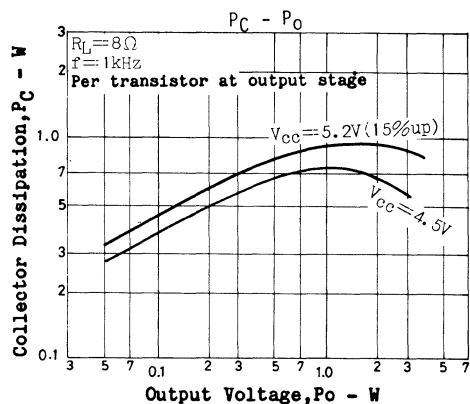
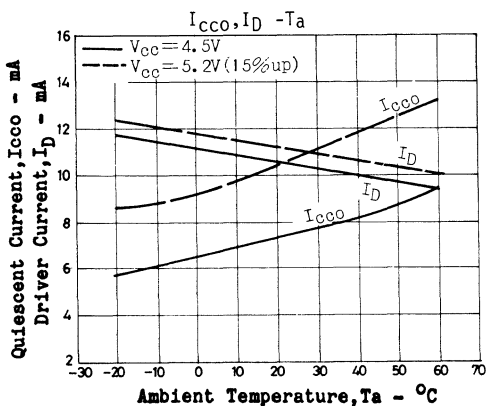
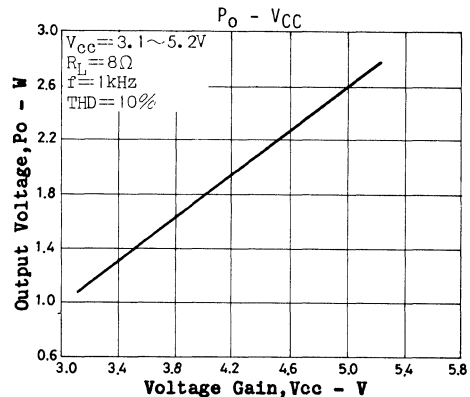
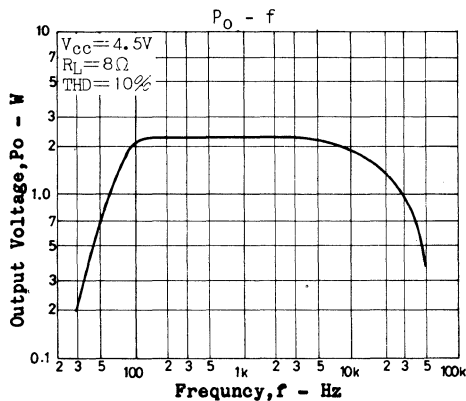
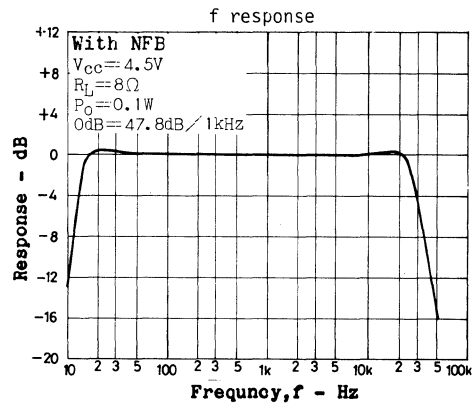
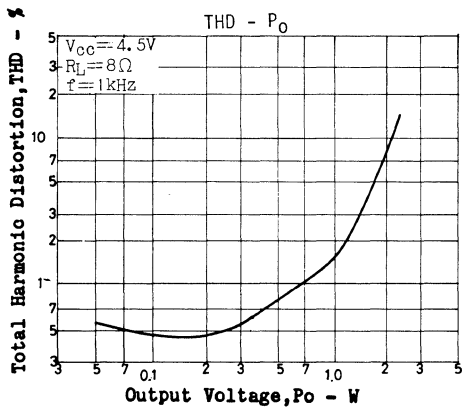
Note: TR3, TR4 must be on the same rank. * R5--- TR1 of rank E: 100ohm
TR1 of rank F: 82ohm

Data on transformer

Transformer name		Impedance		DC resistor	
		Primary	Secondary	Primary	Secondary
Driver transformer	T1 ST-52	600ohm	2Kohm	37ohm	165ohm
Output transformer	T2 GS-1684	14ohm	8ohm	0.24ohm	0.17ohm

[Specification] At $V_{CC}=4.5V$, $R_L=8\Omega$, $R_g=600\Omega$, $f=1kHz$

Quiescent Current	I_{CCO}	Output stage	7.6	mA
	I_D	Driver stage	10.5	mA
Voltage Gain	VG	Without NFB	64.0	dB
	VG	With NFB	48.0	dB
Output Voltage	P_o	THD=10%	2.2	W
	P_o	Output stage: Rank D2	1.7	W
Total Harmonic Distortion	THD	$P_o=0.5W$	0.8	%
Input Resistance	r_i	$P_o=0.5W$	55	kohm



2SD545



2003A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB598

Low Frequency Power Amp, Converter, Electronic Governor Applications

©268H

The 2SB598NP/2SD545NP are complementary pair transistors that are packaged in small packages and are large in current capacity and excellent in saturation characteristic and h_{FE} linearity. In addition to the above application areas, they are also suited for use in desk-top calculator power supplies, relay drivers.

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

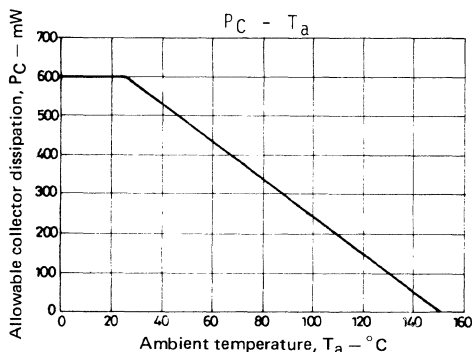
		2SB598	2SD545	unit
Collector to base voltage	V_{CBO}	-25	25	V
Collector to emitter voltage	V_{CEO}	-25	25	V
Emitter to base voltage	V_{EBO}	-5	5	V
Collector current	I_C	-1.0	1.0	A
	i_{cp}	-1.5	1.5	A
Collector dissipation	P_C	600	600	mW
Junction temperature	T_j	150	150	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ~ +150	-55 ~ +150	$^\circ\text{C}$

Electrical Characteristics/ $T_a = 25^\circ\text{C}$

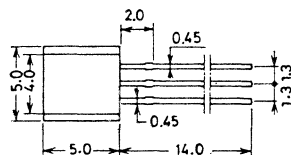
			2SB598		2SD545		unit
			min	typ	min	typ	
Collector cutoff current	I_{CBO}	$V_{CB} = (-)20\text{V}, I_E = 0$				max	
						-1.0	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = (-)4\text{V}, I_C = 0$				max	
						-1.0	μA
Collector to base	$V_{(BR)CBO}$	$I_C = (-)10\mu\text{A}, I_E = 0$	-25		25		V
breakdown voltage							
Collector to emitter	$V_{(BR)CEO}$	$I_C = (-)1\text{mA}, R_{BE} = \infty\Omega$	-25		25		V
breakdown voltage							
Emitter to base	$V_{(BR)EBO}$	$I_E = (-)10\mu\text{A}, I_C = 0$	-5		5		V
breakdown voltage							
DC current gain	$h_{FE}(1)^*$	$V_{CE} = (-)2\text{V}, I_C = (-)50\text{mA}$	60	560	60	560	
	$h_{FE}(2)$	$V_{CE} = (-)2\text{V}, I_C = (-)1\text{A(pulse)}$	30		30		
Gain bandwidth product	f_T	$V_{CE} = (-)10\text{V}, I_C = (-)50\text{mA}$		180		180	MHz
Common base	c_{ob}	$V_{CB} = (-)10\text{V}, f = 1\text{MHz}$		25		15	pF
output capacitance							
Collector to emitter	$V_{CE(sat)}$	$I_C = (-)500\text{mA}, I_B = (-)50\text{mA}$	-0.15	-0.5	0.1	0.3	V
saturation voltage							
Base to emitter	$V_{BE(sat)}$	$I_C = (-)500\text{mA}, I_B = (-)50\text{mA}$	-0.85	-1.2	0.85	1.2	V
saturation voltage							

* $h_{FE}(1)$ is classified by 2 V, 50 mA as follows:

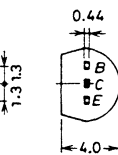
60	D	120	100	E	200	160	F	320	280	G	560
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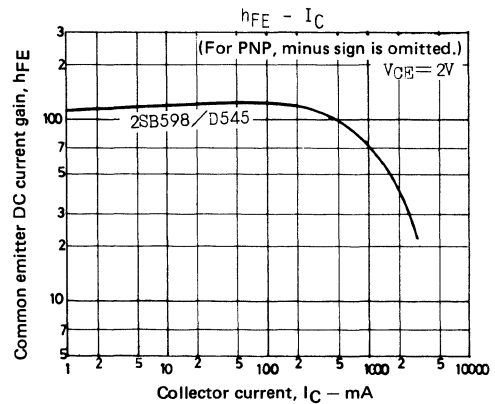
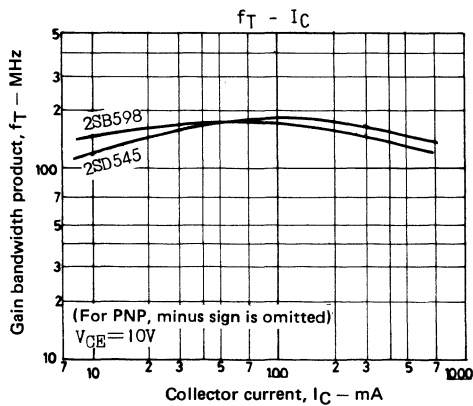
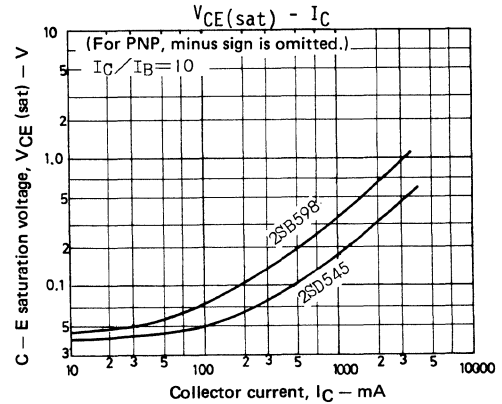
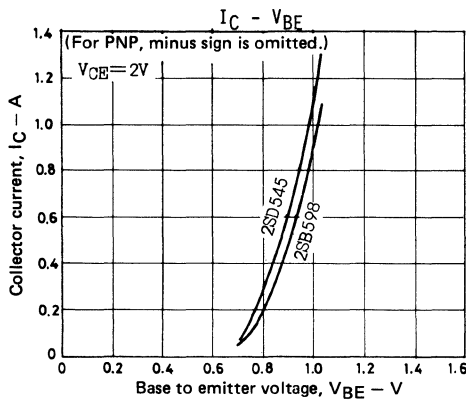
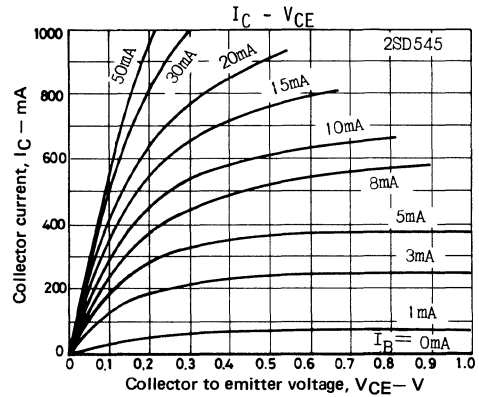
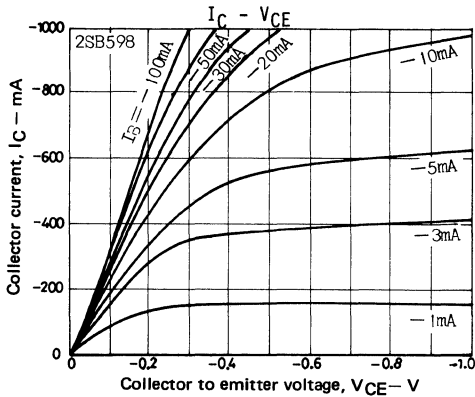
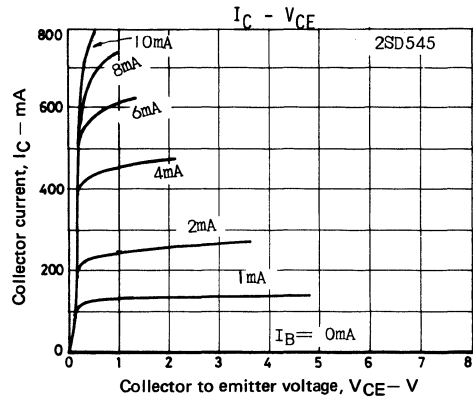
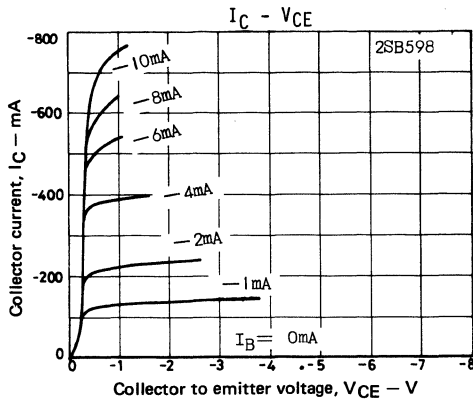
Case Outline 2003A (unit:mm)

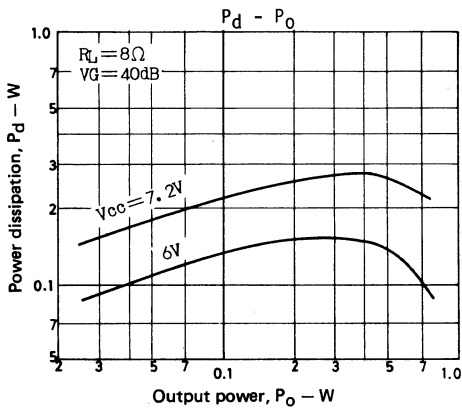
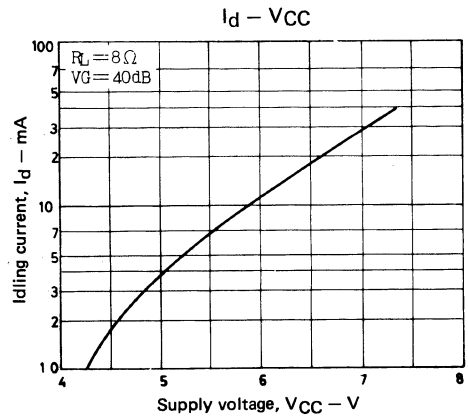
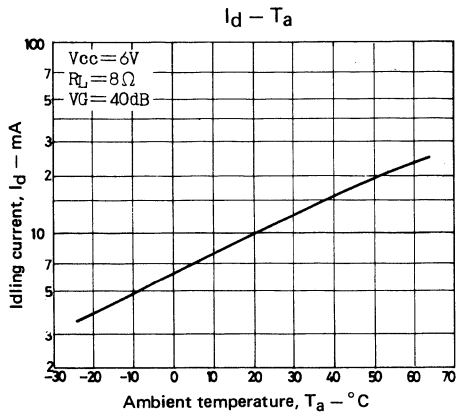


JEDEC: TO-92
EIAJ: SC-43
SANYO: NP



B. Base
C. Collector
E. Emitter





2SD600, 600K



2009

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB631, 631K

Low Frequency Power Amp, Medium Speed Switching Applications

Ⓔ346E

Features

- High breakdown voltage V_{CEO} 100/120V, high current 1A.
- Low saturation voltage and good linearity of h_{FE} .

(): 2SB631, 631K

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

	2SB631, D600	2SB631K, D600K	unit
Collector to Base Voltage V_{CBO}	(-) 100	(-) 120	V
Collector to Emitter Voltage V_{CEO}	(-) 100	(-) 120	V
Emitter to Base Voltage V_{EBO}	(-) 5		V
Collector Current I_C	(-) 1		A
Peak Collector Current i_{cp}	(-) 2		A
Collector Power Dissipation P_C	1		W
	$T_C=25^{\circ}\text{C}$	8	W
Junction Temperature T_j	150		$^{\circ}\text{C}$
Storage Temperature T_{stg}	-55 to +150		$^{\circ}\text{C}$

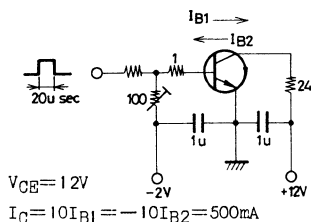
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

		min	typ	max	unit
Collector to Base Breakdown Voltage $V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	B631, D600 (-) 100			V
Collector to Emitter Breakdown Voltage $V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	B631K, D600K (-) 120			V
Emitter to Base Breakdown Voltage $V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$	(-) 5			V
Collector Cutoff Current I_{CBO}	$V_{CB}=(-)50\text{V}, I_E=0$	(-) 1			μA
Emitter Cutoff Current I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$	(-) 1			μA
DC Current Gain $h_{FE(1)}$	$V_{CE}=(-)5\text{V}, I_C=(-)50\text{mA}$	60*		320*	
$h_{FE(2)}$	$V_{CE}=(-)5\text{V}, I_C=(-)500\text{mA}$	20			
Gain Bandwidth Product f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$	(110)			MHz
		130			
Output Capacitance c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$	(30)			pF
		20			

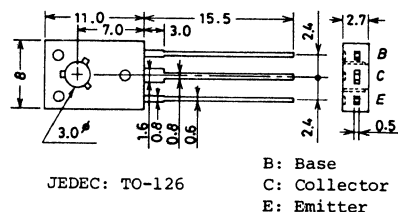
* The 2SB631, 2SD600 are classified by 50mA h_{FE} as follows:

60	D	120	100	E	200	160	F	320
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Switching Time Test Circuit

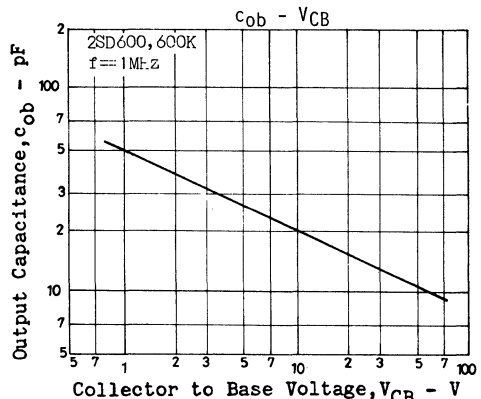
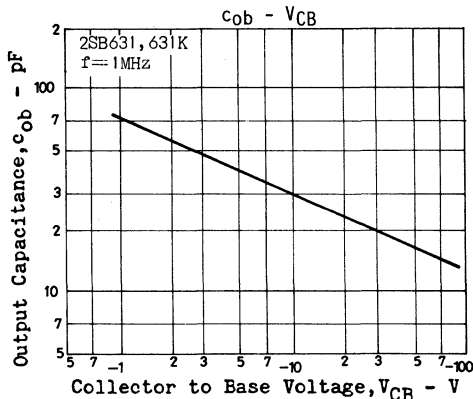
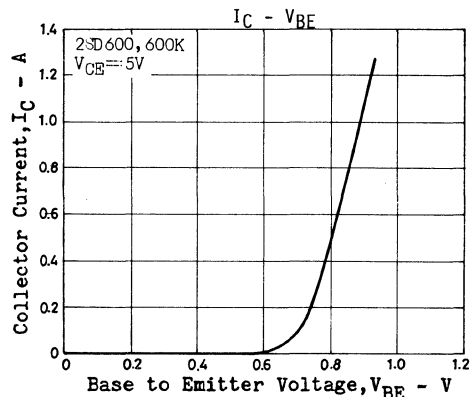
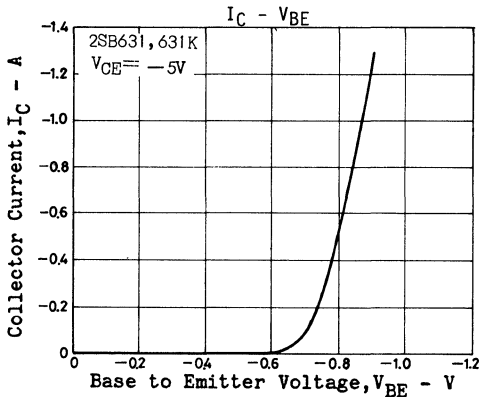
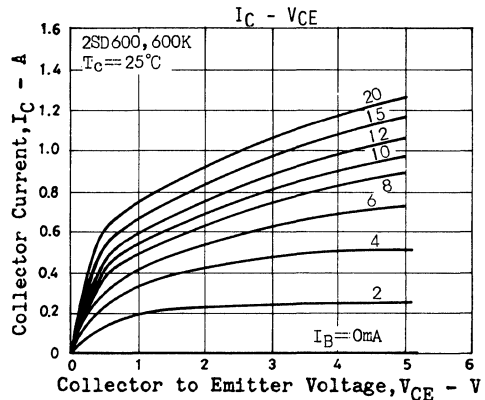
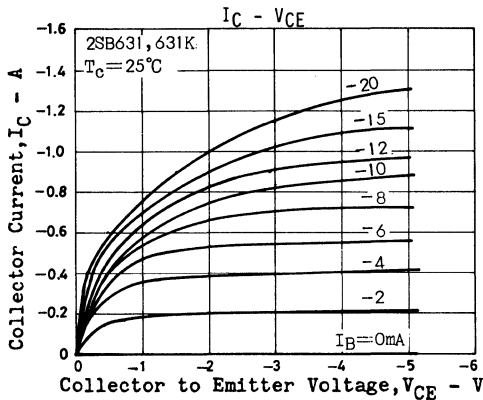


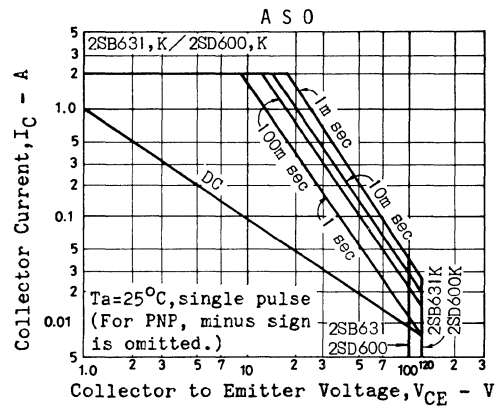
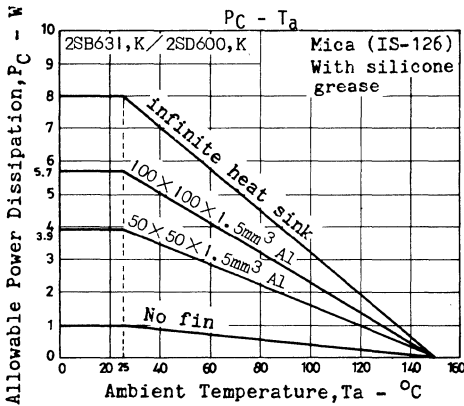
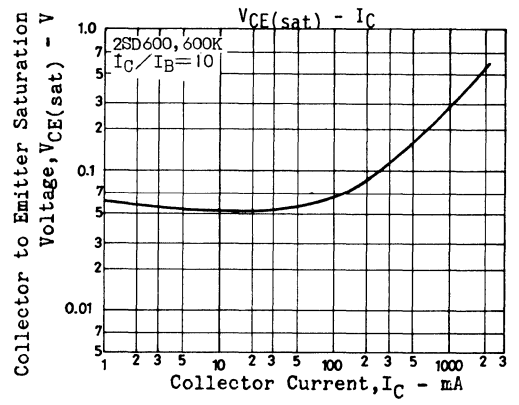
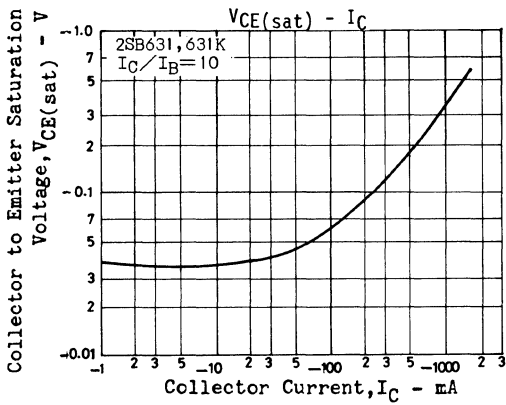
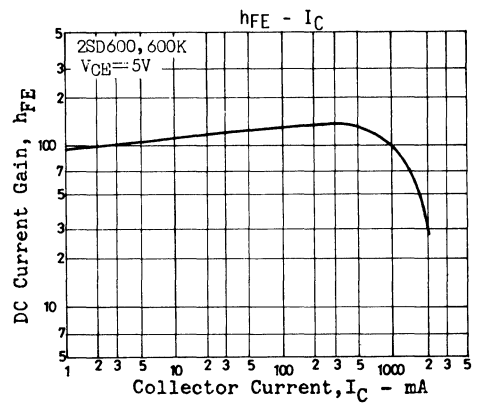
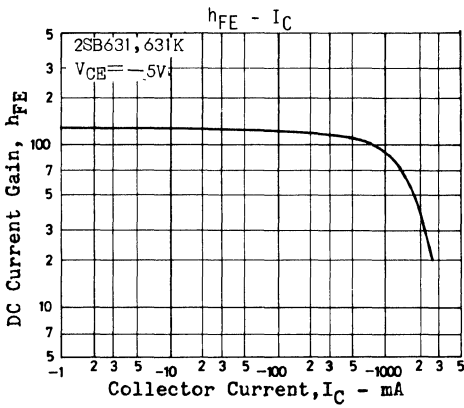
Case Outline 2009 (unit:mm)



2SD600,600K/2SB631,631K

			min	typ	max	unit
Output Capacitance	c_{ob}	$V_{CB}=(-)10V, f=1MHz$		(30)		
				20		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500mA, I_B=(-)50mA$		(-)	0.15(-)0.4	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500mA, I_B=(-)50mA$		(-)	0.85(-)1.2	V
Fall Time	t_f	at test circuit	(80)	100		ns
Turn-off Time	t_{off}	"	(100)	500		ns
Storage Time	t_{stg}	"	(600)	700		ns





2SD612, 612K



NPN/PNP Epitaxial Planar
Silicon Transistors

2009

2SB632, 632K

Low Frequency Power Amp, Medium Speed Switching Applications

©341E

Features

- Large allowable collector dissipation and wide ASO.

(): 2SB632,632K

Absolute Maximum Ratings at Ta=25°C

		2SB632,D612	2SB632K,D612K	unit
Collector to Base Voltage	V_{CB0}	(-) 25	(-) 35	V
Collector to Emitter Voltage	V_{CE0}	(-) 25	(-) 35	V
Emitter to Base Voltage	V_{EB0}	(-)5		V
Collector Current	I_C	(-)2		A
	i_{cp}	(-)3		A
Collector Dissipation	P_C	1		W
		$T_C=25^{\circ}\text{C}$	10	W
Junction Temperature	T_j	150		°C
Storage Temperature	T_{stg}	-55 to +150		°C

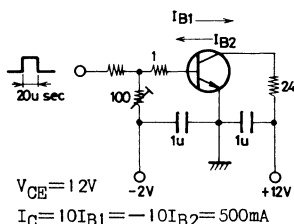
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}$ $I_E=0$	(-)25			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}$ $R_{BE}=\infty$	(-)25			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$	(-)5			V
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)20\text{V}, I_E=0$			(-)1	uA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)1	uA
DC Current Gain	$h_{FE(1)}$	$V_{CE}=(-)2\text{V}, I_C=(-)500\text{mA}$	60*		320*	
	$h_{FE(2)}$	$V_{CE}=(-)2\text{V}, I_C=(-)1.5\text{A}$	30			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		100		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$	(	30 (45)	)	pF

* 2SB632,2SD612 are classified by 500mA h_{FE} as follows:

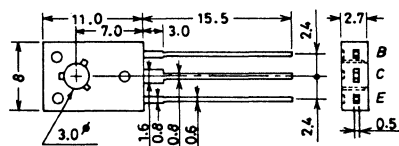
60	D	120	100	E	200	160	F	320
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Switching Time Test Circuit



Case Outline 2009

(unit:mm)

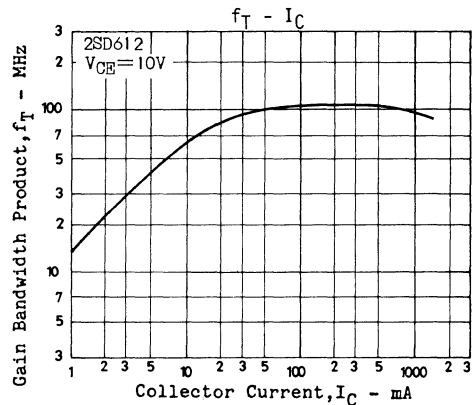
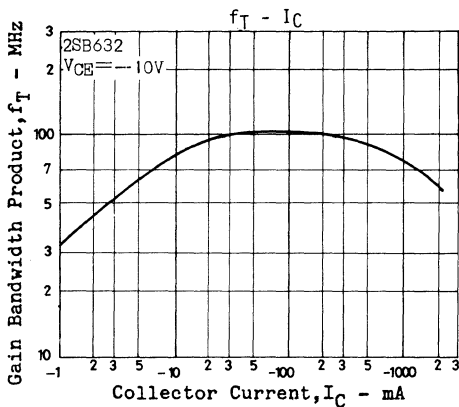
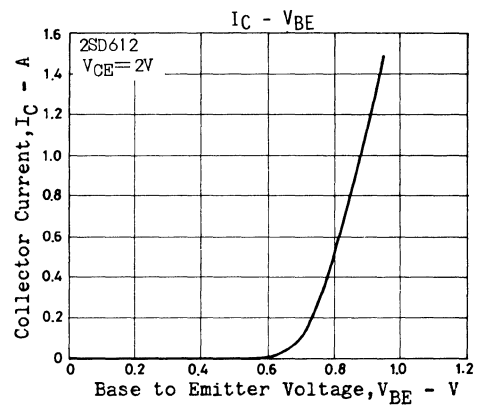
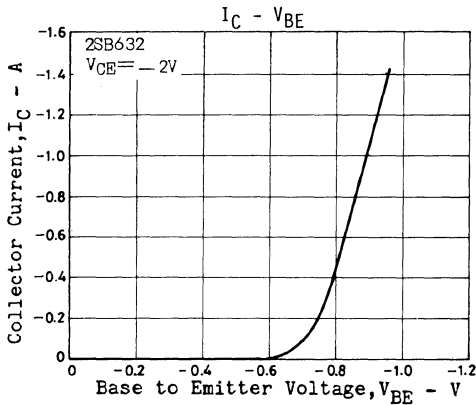
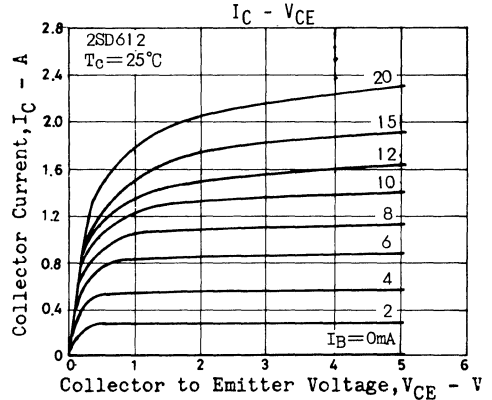
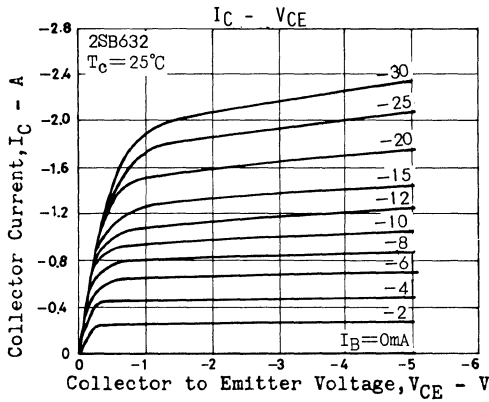


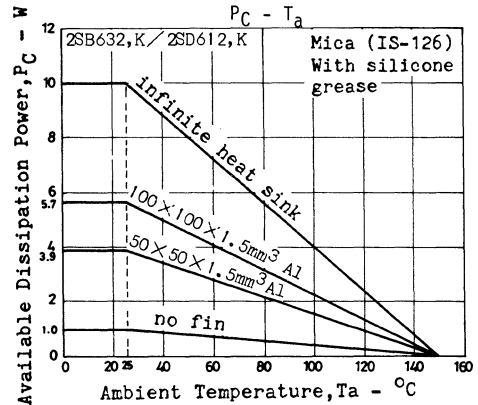
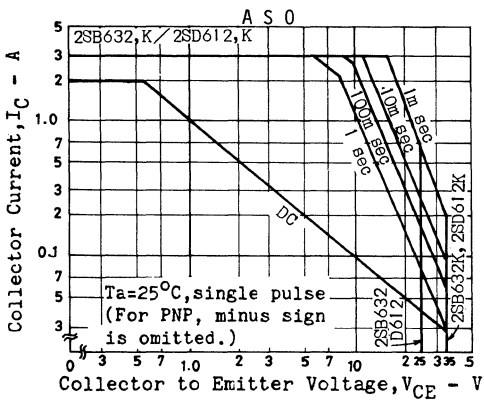
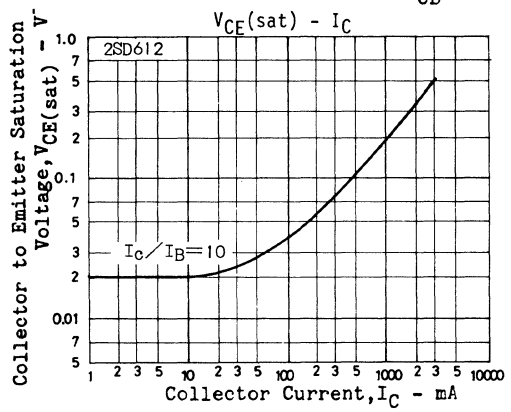
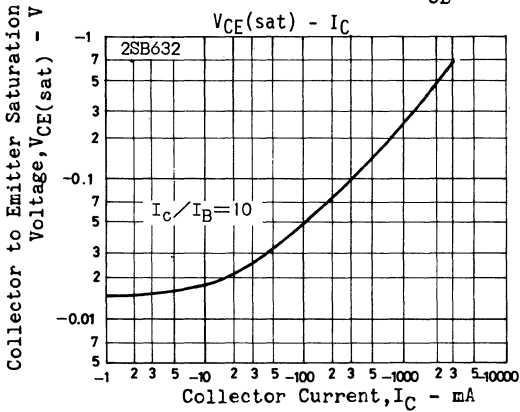
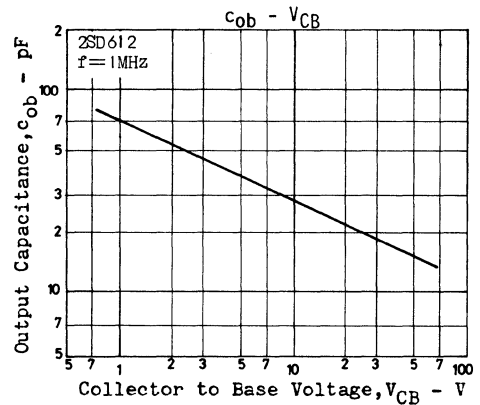
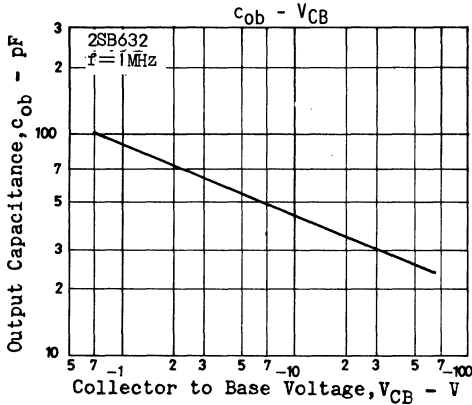
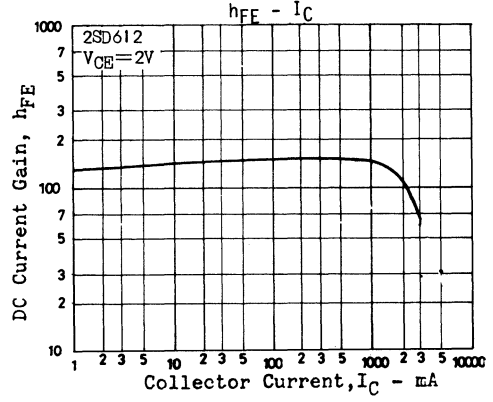
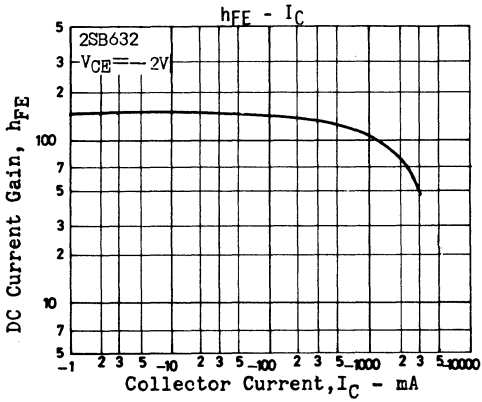
JEDEC: TO-126

B: Base
C: Collector
E: Emitter

D174MY,TS/E108/No.341-1/7

			min	typ	max	unit
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = (-)1.5A$, $I_B = (-)0.15A$	(0.3	0.8	)	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C = (-)1.5A$, $I_B = (-)0.15A$	(-0.4)	(-0.9)		V
Turn-on Time	t_{on}	at test circuit	(60)	50		ns
Storage Time	t_f	"	(80)	100		ns
Fall Time	t_{stg}	"		400		ns



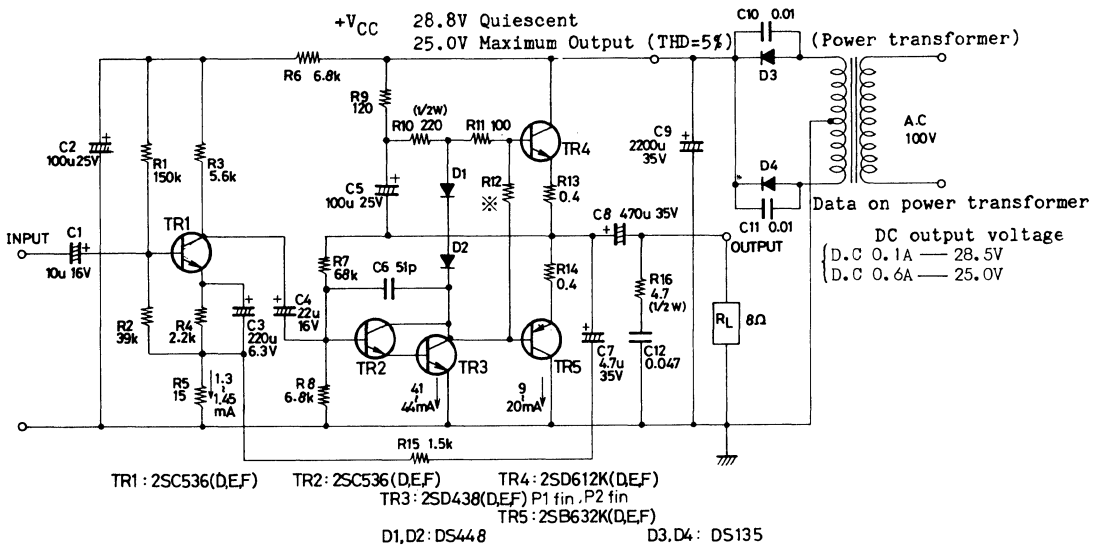


2SD612,612K/2SB632,632K

Sample Application Circuit 1: 2SB632K/2SD612K-Used 8W Symmetrical Complementary Amp

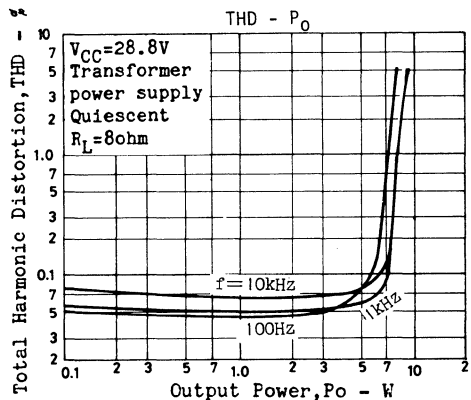
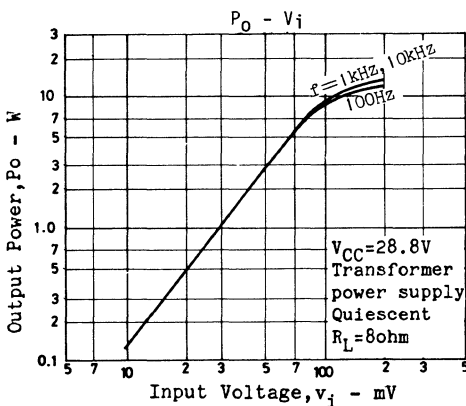
[Specification] Power supply---AC 100V Transformer voltage, at quiescent mode=28.8V, at maximum output mode(THD=5%)=25V, $f=1\text{KHz}$, $R_L=8\text{ohm}$
 $R_g=600\text{ohm}$

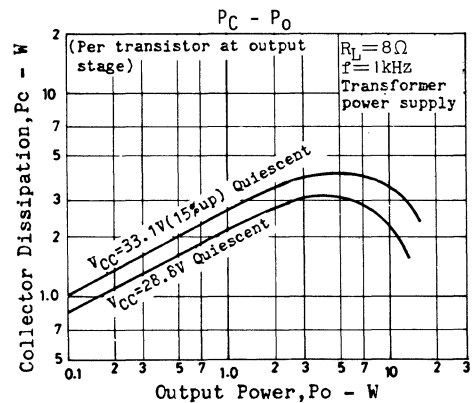
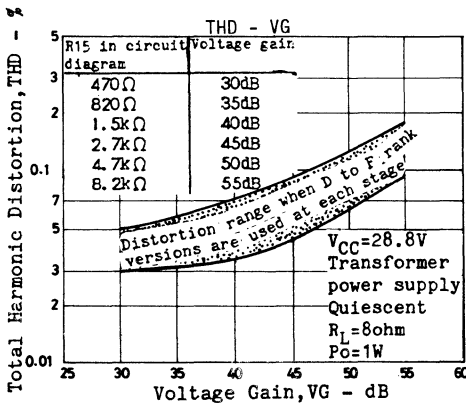
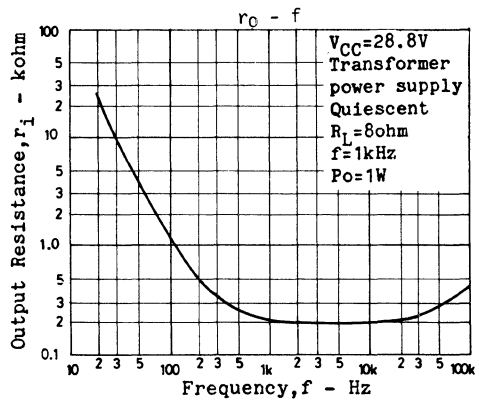
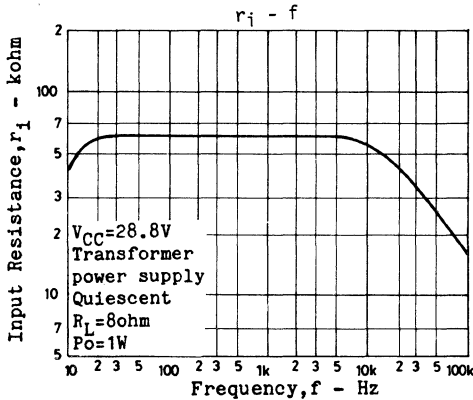
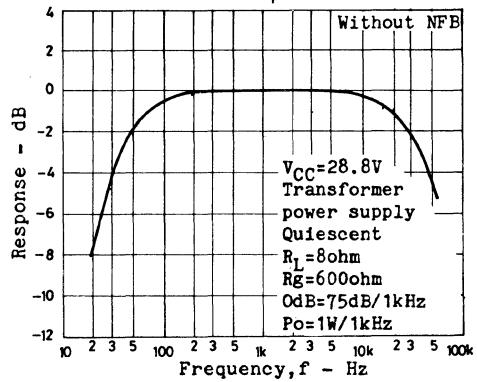
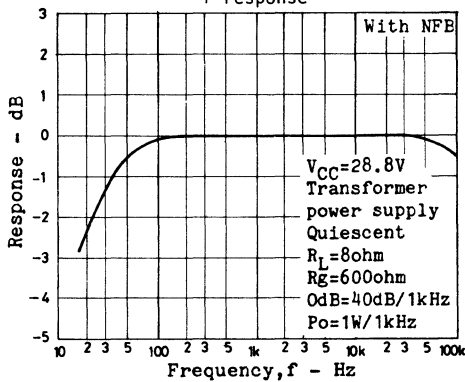
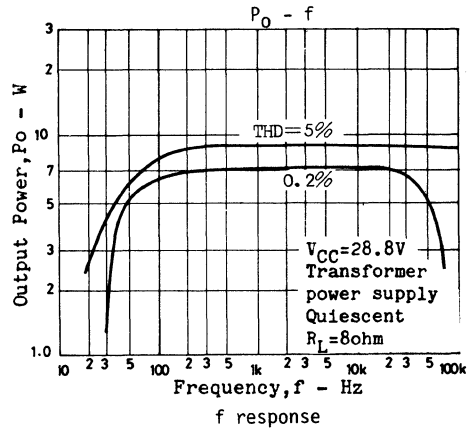
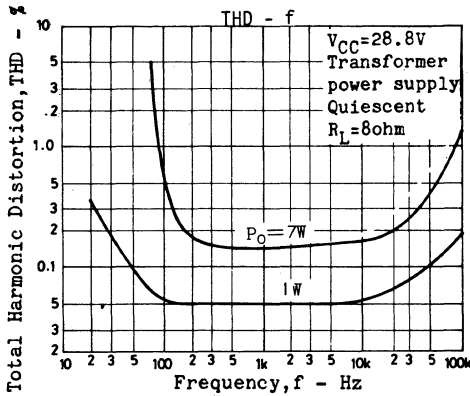
Quiescent current (Collector current)	$\begin{cases} I_{ce0} \\ I_D \\ I_C \end{cases}$	Output stage Driver stage First stage	typ	
Voltage gain	$\begin{cases} V_G \\ V_G \end{cases}$	Without NFB	75	dB
		With NFB	40	dB
Output power	P_o	THD=5%	8.7	W
Total harmonic distortion	THD	$P_o=1\text{W}$	0.05	%
Input resistance	r_i	$P_o=1\text{W}$	60k	ohm
Output Resistance	r_o	$P_o=1\text{W}$	0.2	ohm

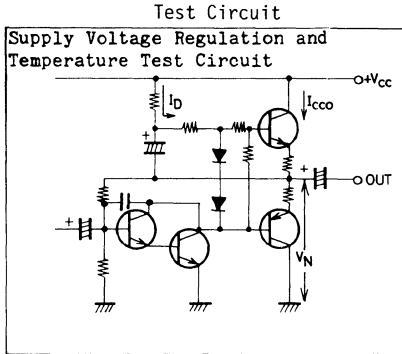
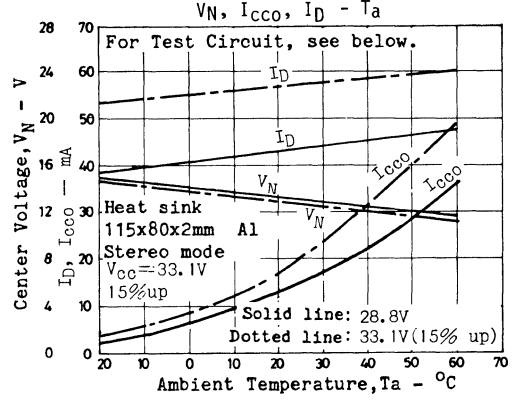
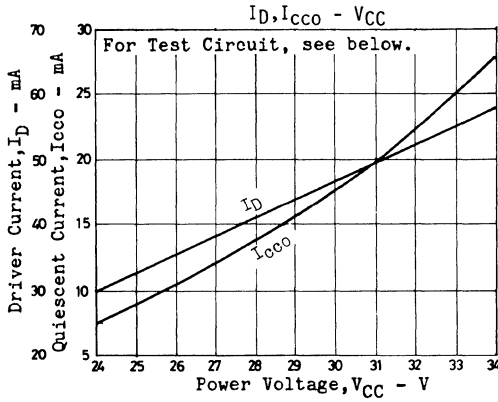


Note: TR3: With P1 fin or P2 fin

※ TR4, TR5: D, E rank version $R_{12}=560\text{ohm}$
 F rank version $R_{12}=470\text{ohm}$) Must be paired in the same rank.



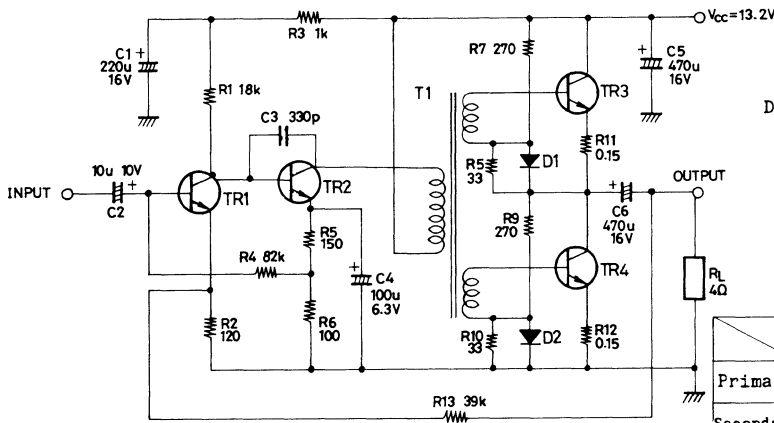




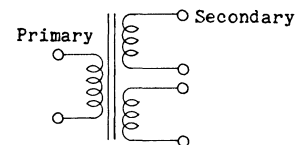
Sample Application Circuit 2: 2SD612-Used 4W Input Transformer
Coupling Amp for Car Use

[Specification] $V_{CC}=13.2V$, $R_L=4\Omega$, $R_g=600\Omega$, $f=1kHz$

Quiescent current (Collector current)	I_{CCO}	Output stage	12.0	mA
	I_D	Driver stage	9.0	mA
Voltage gain	VG	Without NFB	66	dB
	VG	With NFB	49	dB
Output power	P_o	THD=10%	4.7	W
Total harmonic distortion	THD	$P_o=0.5W$	0.8	%
Input impedance	r_i	$P_o=0.5W$	60k	ohm



Data on transformer (T1)



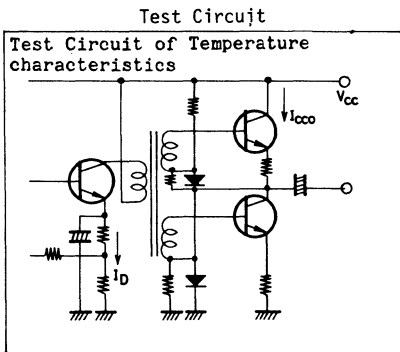
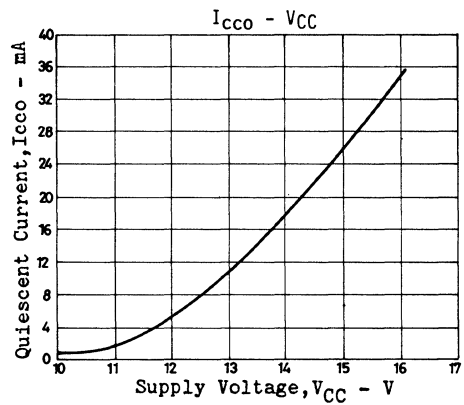
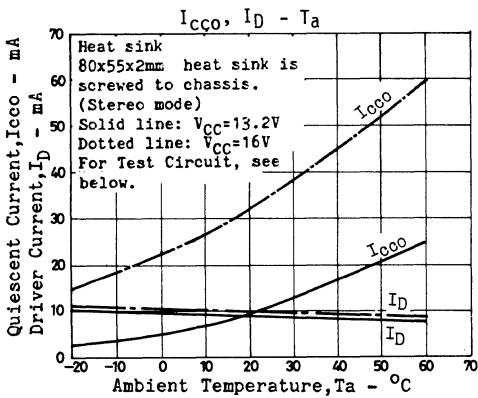
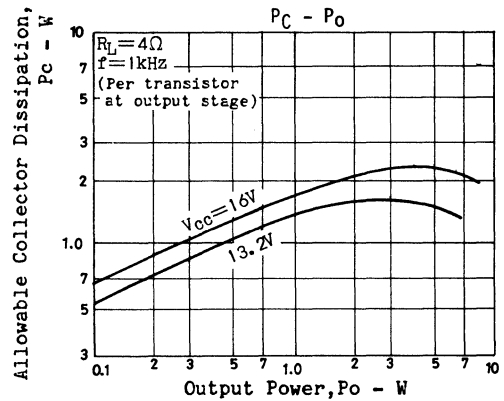
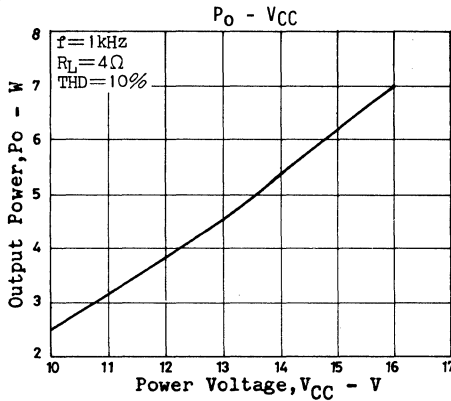
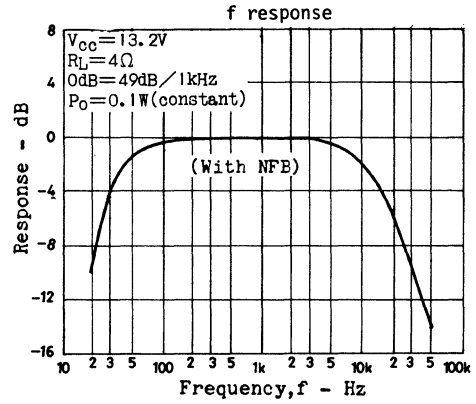
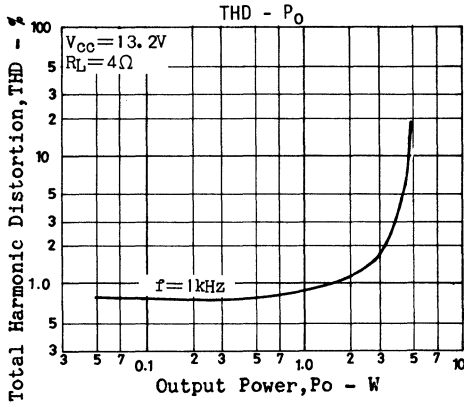
	Impedance	DC resistance
Primary	3k Ω	180 Ω
Secondary	400 Ω	18 Ω

TR1: 2SC536(E,F)

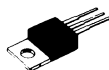
2SC1175(E,F)
TR2

D1, D2: DS442
TR3, 4: 2SD612(E,F)

(Must be paired in the same rank.)



2SD613



2010A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB633

High Voltage Switching, AF 25 to 30W Output Applications

©513E

(): 2SB633

Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CBO}	(-)100	V
Collector to Emitter Voltage	V_{CEO}	(-)85	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)6	A
Peak Collector Current	i_{cp}	(-)10	A
Collector Dissipation	P_C	40	W
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

$T_C=25^\circ C$

Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40V, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$			(-)0.1	mA
DC Current Gain	$h_{FE(1)}^*$	$V_{CE}=(-)5V, I_C=(-)1A$	40*		320*	
	$h_{FE(2)}$	$V_{CE}=(-)5V, I_C=(-)3A$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)5V, I_C=(-)1A$		15		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)4A, I_E=(-)0.4A$			(-)2.0	V
B-E Rise Voltage	V_{BE}	$V_{CE}=(-)5V, I_C=(-)1A$			(-)1.5	V
Output Capacitance	c_{ob}	$V_{CB}=(-)10V, f=1MHz$		(150)		pF
				110		pF
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5mA, I_E=0$	(-)100			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)5mA, R_{BE}=\infty$	(-)85			V
	"	$I_C=(-)50mA, R_{BE}=\infty$	(-)85			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)5mA, I_C=0$	(-)6			V

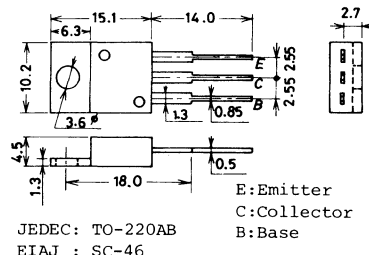
* The 2SB633/2SD613 are classified by 1A h_{FE} as follows:

40	C	80	60	D	120	100	E	200	160	F	320
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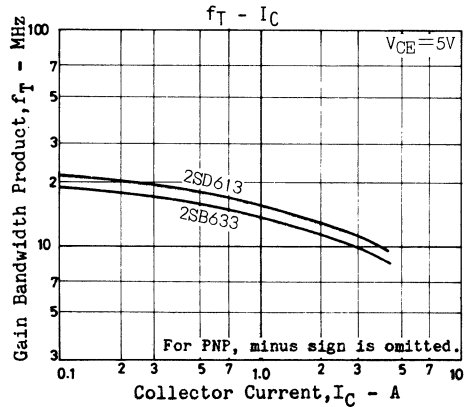
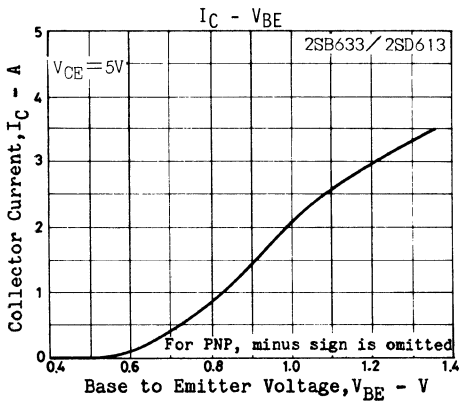
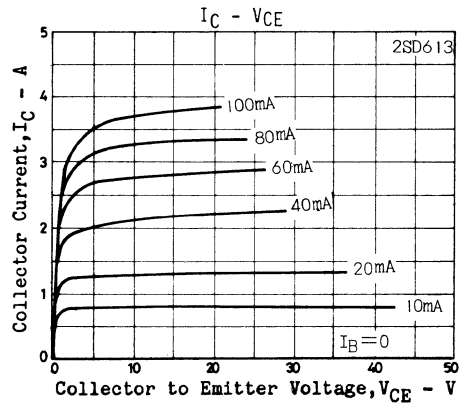
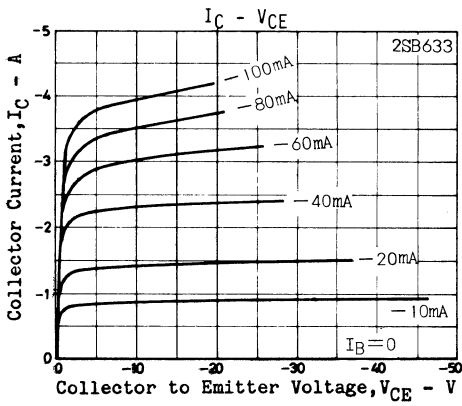
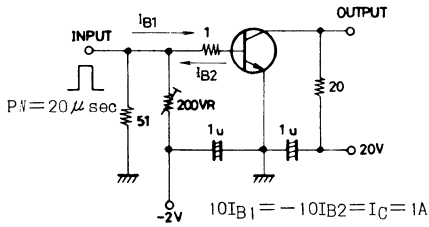
.The switching time characteristic and test circuit are shown on next page.

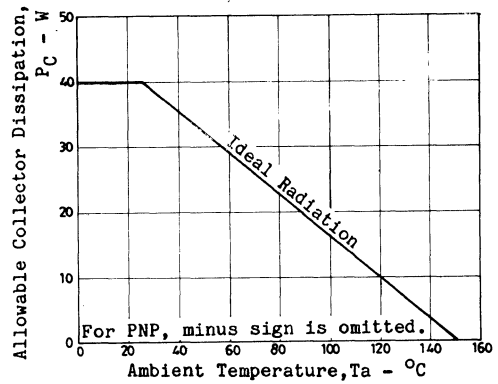
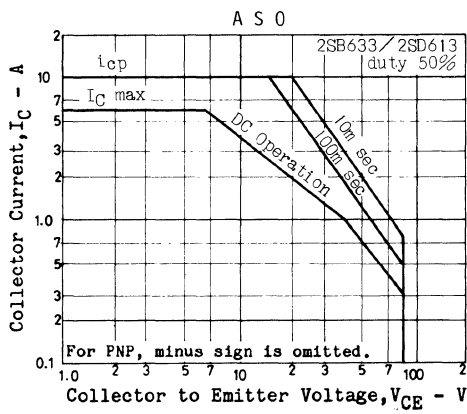
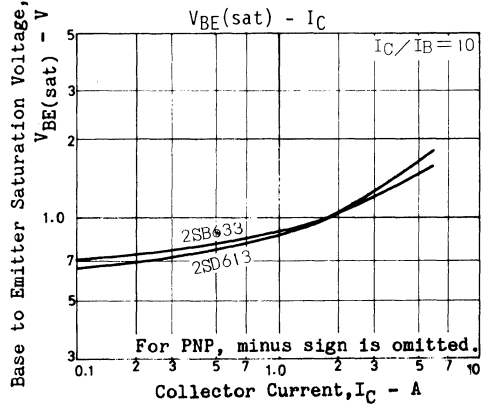
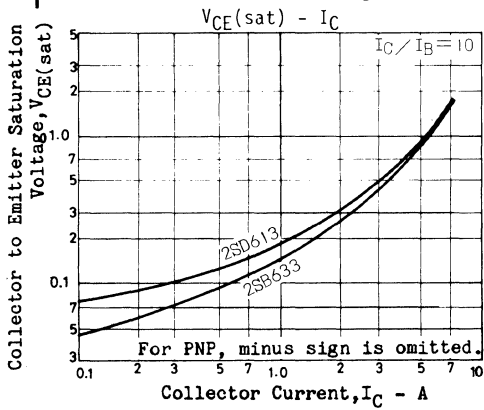
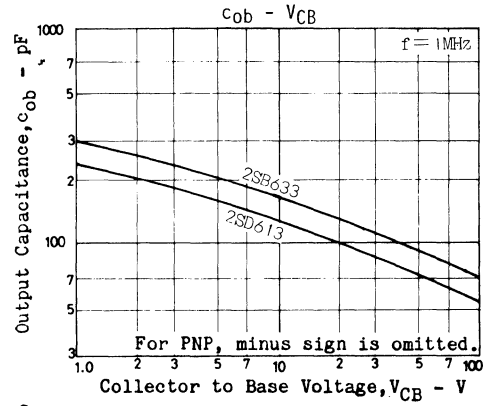
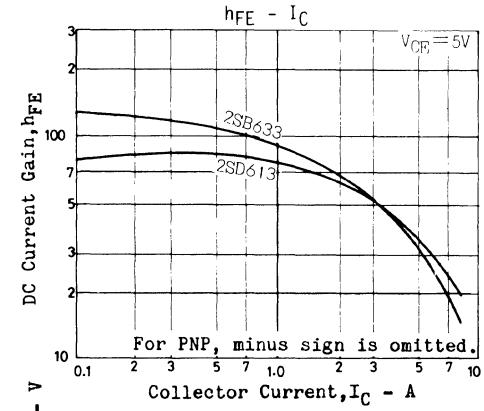
Case Outline 2010A

(unit:mm)



			min	typ	max	unit
Turn-on Time	t_{on}	at Test Circuit shown below		(0.16)		usec
Fall Time	t_f	"		0.28		usec
Storage Time	t_{stg}	"		(1.45)		usec
				3.60		usec
				(0.33)		usec
				0.50		usec

Switching Time Test Circuit



2SD734



2003A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB698

AF 1W Output, Electronic Governor, D-D Converter Applications

©512E

() : 2SB698 for audio 1W output.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)25	V
Collector to Emitter Voltage	V_{CEO}	(-)20	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)0.7	A
Peak Collector Current	i_{cp}	(-)1.5	A
Collector Dissipation	P_C	0.6	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

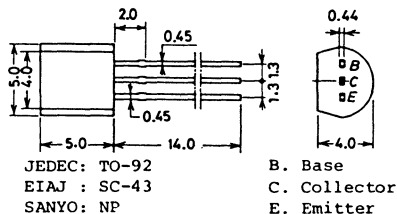
Electrical Characteristics at $T_a=25^\circ\text{C}$

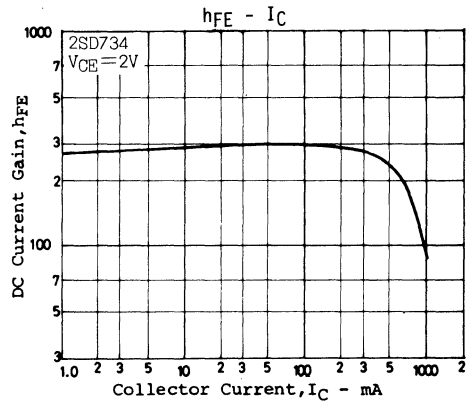
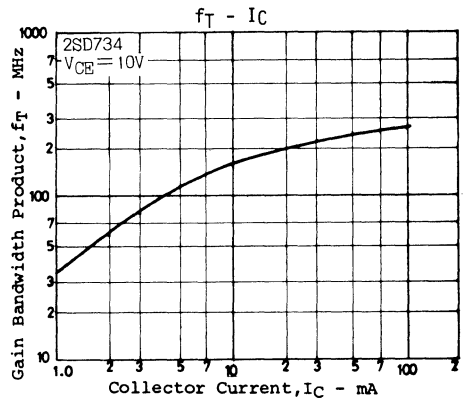
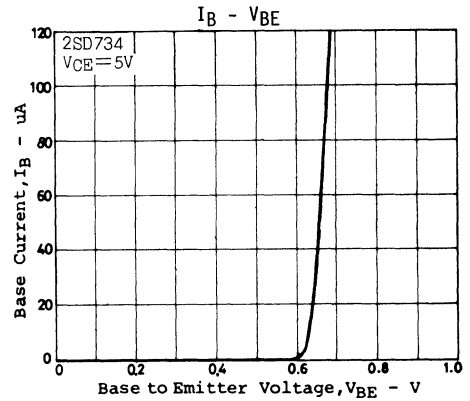
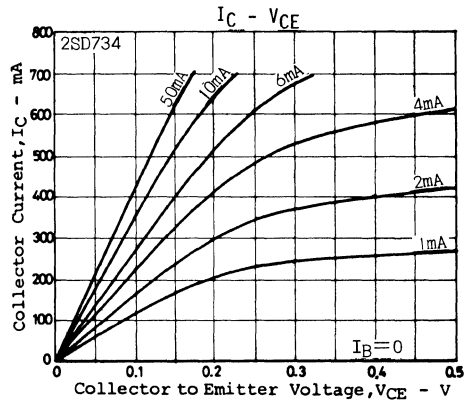
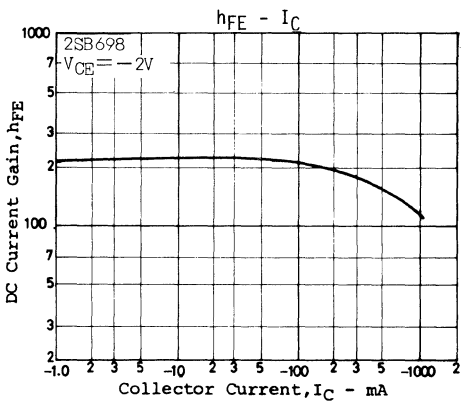
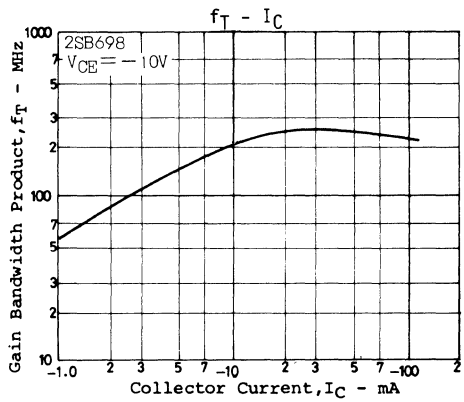
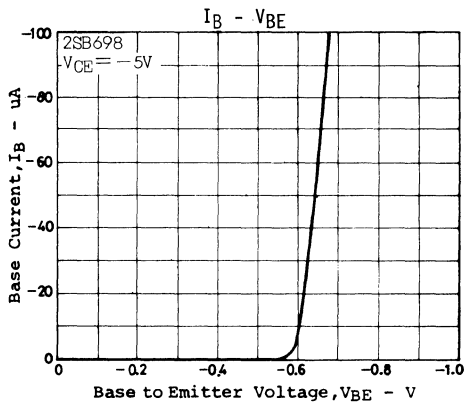
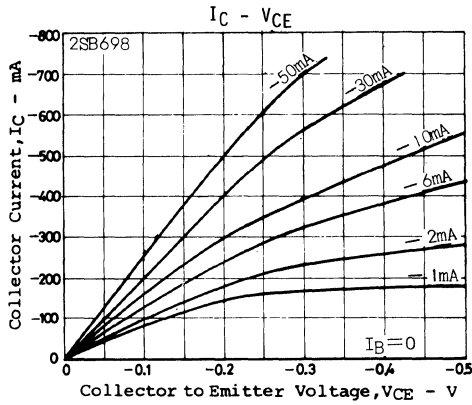
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)20\text{V}, I_E=0$	(-)1.0			μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$	(-)1.0			μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)2\text{V}, I_C=(-)50\text{mA}$	60*		560*	
	$h_{FE}(2)$	$V_{CE}=(-)2\text{V}, I_C=(-)500\text{mA}$	50			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		250		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(13)		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500\text{mA}, I_B=(-)50\text{mA}$		0.2 (-0.45)		V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500\text{mA}, I_B=50\text{mA}$		(-)0.9		V
C-B Saturation Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)25			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	(-)20			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_C=(-)10\mu\text{A}, I_C=0$	(-)5			V

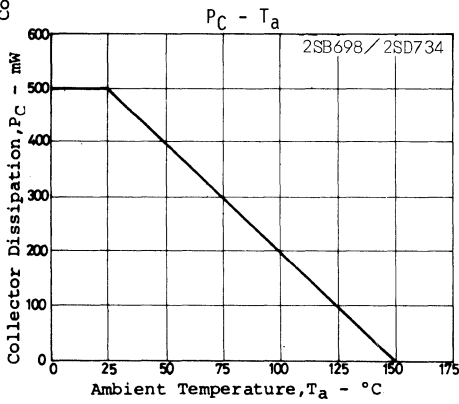
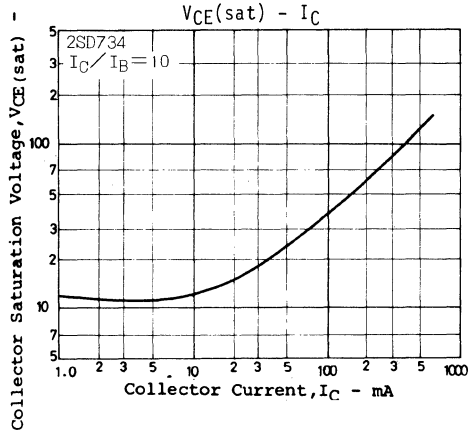
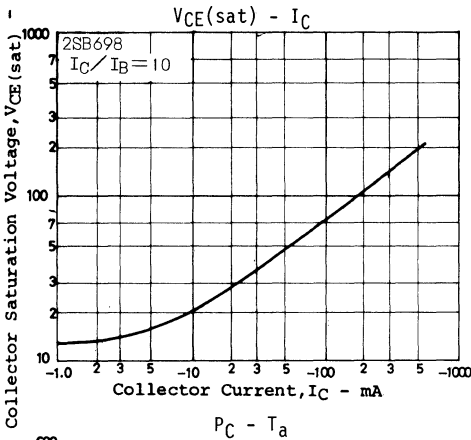
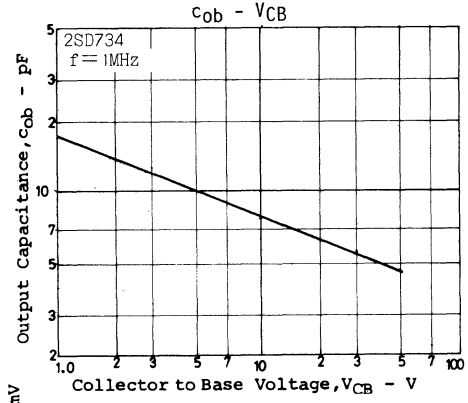
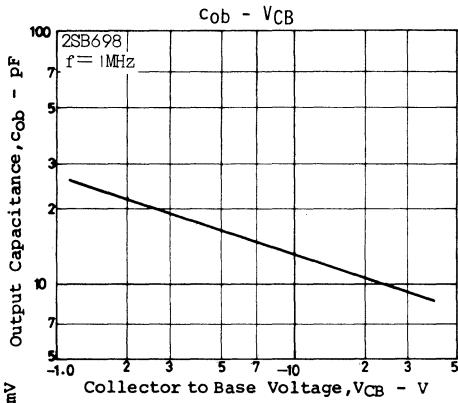
*2SB698 and 2SD734 are graded as follows by h_{FE} at 1A :

60	D	120	100	E	200	160	F	320	280	G	560
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Case Outline 2003A (unit:mm)







2SD823



B/W TV Horizontal Output Applications

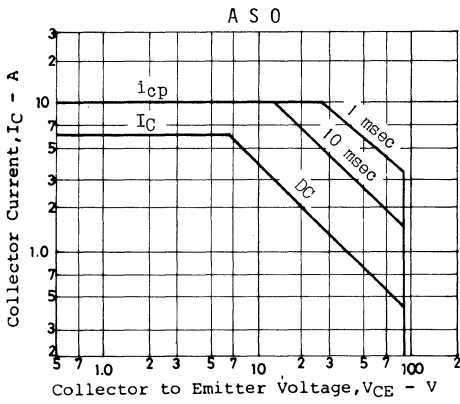
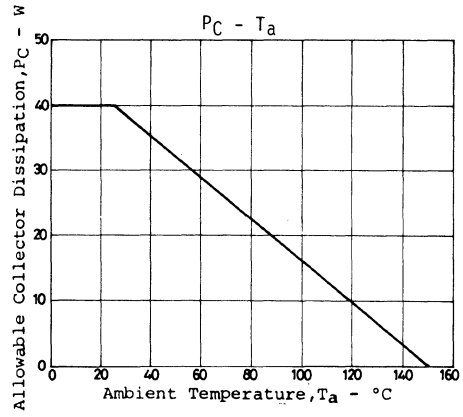
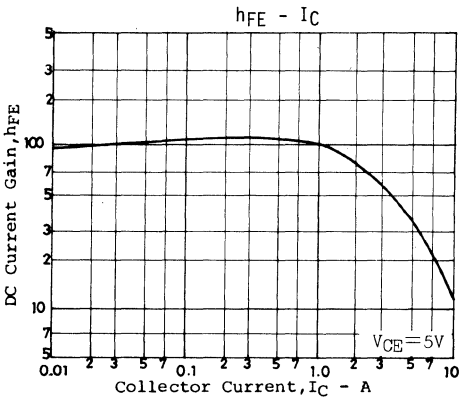
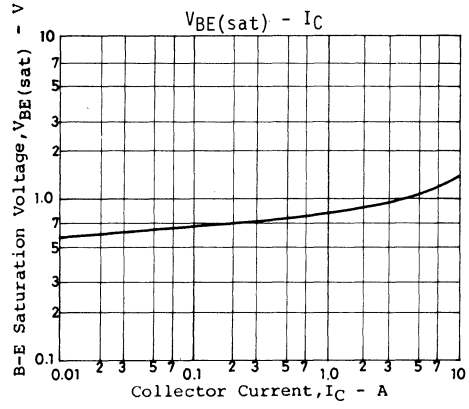
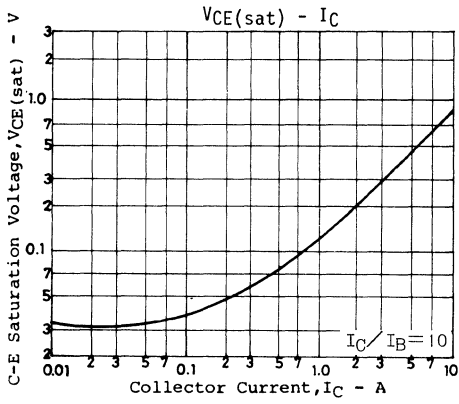
Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

Solute Maximum Ratings at T _a =25°C			unit
Collector to Base Voltage	V _{CBO}	200	V
Collector to Emitter Voltage	V _{CEO}	90	V
Emitter to Base Voltage	V _{EB0}	7	V
Collector Current	I _C	6	A
Peak Collector Current	i _{cp}	10	A
Collector Dissipation	P _C	40	W
Junction Temperature	T _j	150	°C
Storage Temperature	T _{stg}	-55 to +150	°C

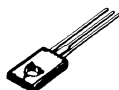
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=40\text{V}, I_E=0$			0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4\text{V}, I_C=0$			0.1	mA
Collector to Base Voltage	V_{CBO}	$I_C=5\text{mA}, I_E=0$	200			V
Collector to Emitter Voltage	V_{CEO}	$I_C=5\text{mA}, I_B=0$	90			V
Emitter to Base Voltage	V_{EBO}	$I_E=5\text{mA}, I_C=0$	7			V
DC Current Gain	h_{FE}	$V_{CE}=5\text{V}, I_C=3\text{V}$	20			
Gain Bandwidth Product	f_T	$V_{CE}=5\text{V}, I_C=1\text{A}$		15		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=5\text{A}, I_B=0.5\text{A}$			1.5	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=5\text{A}, I_B=0.5\text{A}$			1.5	V
Fall Time	t_f	$I_C=5\text{A}, I_{B1}=0.6\text{A}$			1.0	us

[illegible]



2SD826



2009

NPN Epitaxial Planar
Silicon Transistor

3V, 6V Strobe Applications

©538D

Features

- . Low saturation voltage.
- . High h_{FE} .
- . Large current capacity.

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	60	V
Collector to Emitter Voltage	V_{CE0}	20	V
Emitter to Base Voltage	V_{EB0}	6	V
Collector Current	I_C	5	A
Peak Collector Current	i_{cp}	100ms, 1 pulse	8 A
Collector Dissipation	P_C	1.0	W
	$T_c=25^{\circ}\text{C}$	10	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

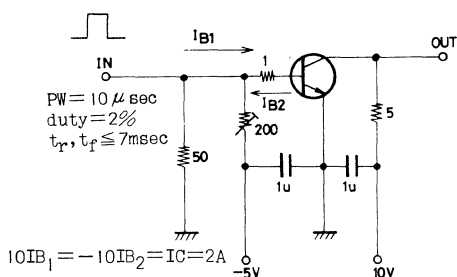
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=50\text{V}, I_E=0$			1.0	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=5\text{V}, I_C=0$			1.0	μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=2\text{V}, I_C=0.5\text{A}$	120*		560*	
	$h_{FE}(2)$	$V_{CE}=2\text{V}, I_C=3\text{A(Pulse)}$	95			
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=50\text{mA}$		120		MHz
Output Capacitance	c_{ob}	$V_{CB}=10\text{V}, f=1\text{MHz}$		45		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=3\text{A}, I_B=60\text{mA(Pulse)}$			0.5	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=3\text{A}, I_B=60\text{mA(Pulse)}$			1.5	V
Turn On Time	t_{on}	at test circuit		30		ns
Fall Time	t_f	"		40		ns
	t_{stg}	"		300		ns

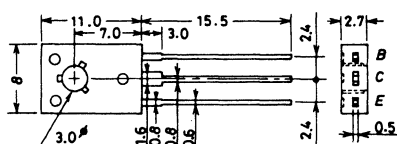
*: The 2SD826 is classified by 0.5A h_{FE} as follows:

120	E	200	160	F	320	280	G	560
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Switching Time Test Circuit

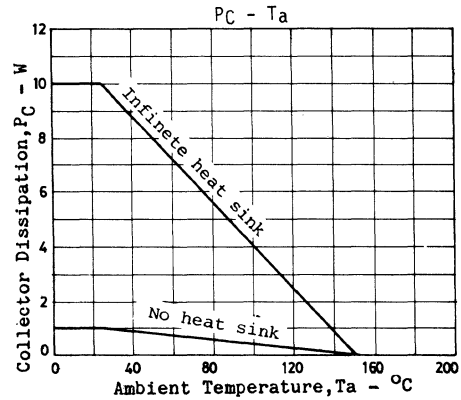
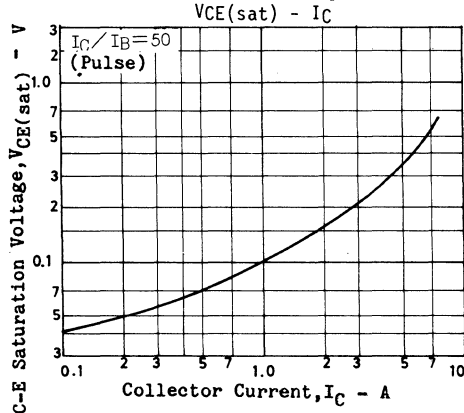
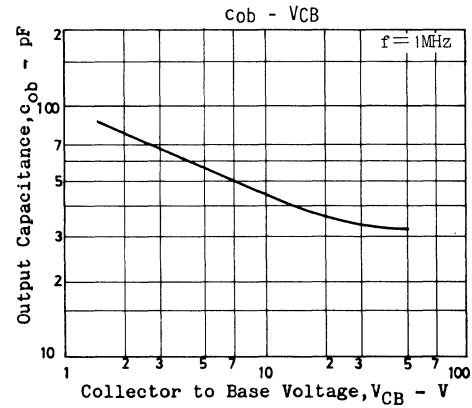
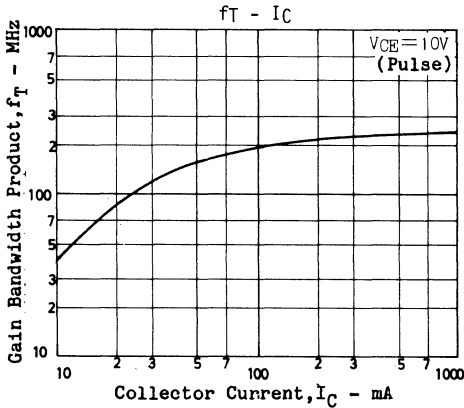
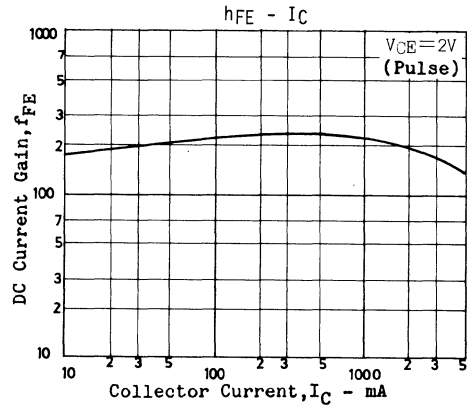
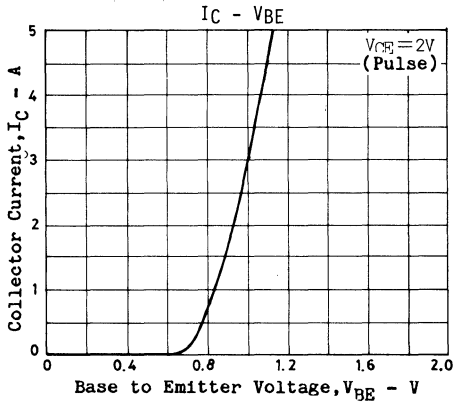
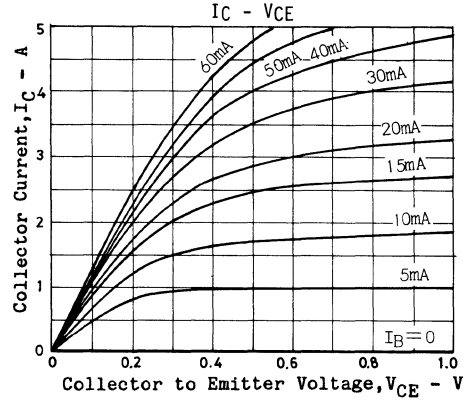
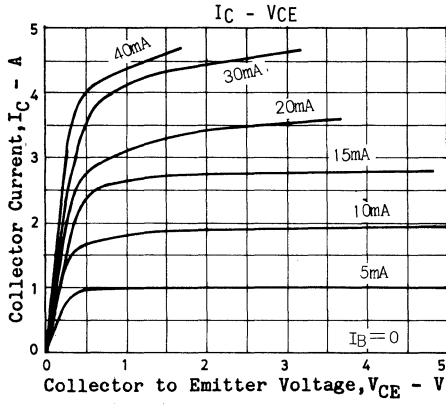


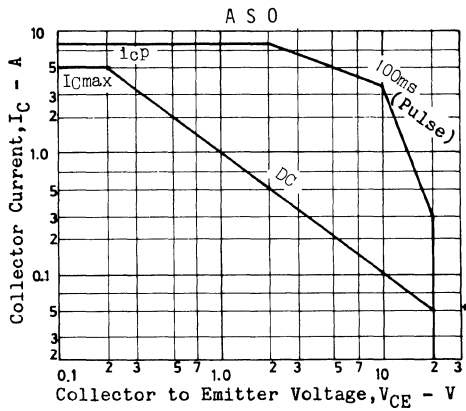
Case Outline 2009 (unit:mm)



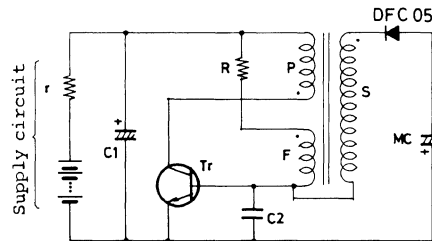
JEDEC: TO-126

B: Base
C: Collector
E: Emitter

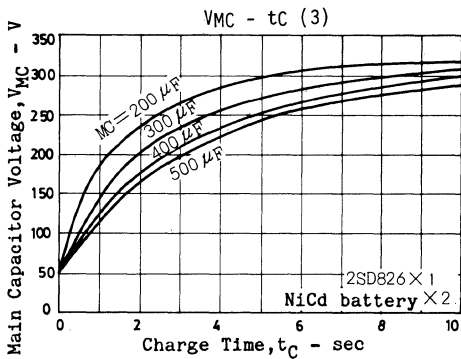
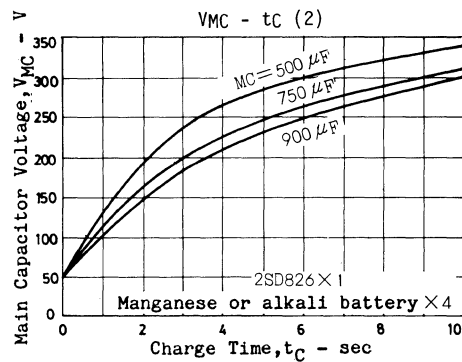
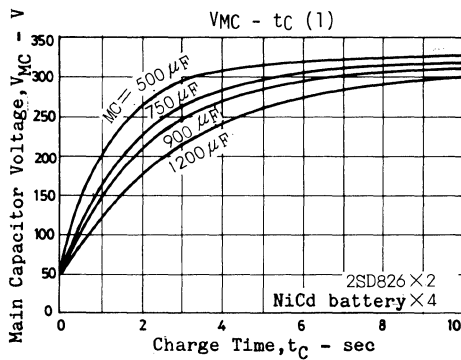




Sample Application Circuit 1 : Electronic flash set



	E[V]	r[Ω]	MC[μF]	C1[μF]	R[kΩ]	C2[μF]	Tr	P	F	S	Core
NiCd ×2	2.7	0.15	~500	100	2.2	0.01	2SD826 FG	0.55 ∅ × 103/4T	0.23 ∅ × 123/4T	0.07 ∅ × 1350T	EE13
Alkali or manganese ×4	6.0	1.2	500 ~900	100	4.7	0.015	2SD826 EFG	0.6 ∅ × 223/4T	0.23 ∅ × 203/4T	0.08 ∅ × 1390T	EE16
NiCd ×4	5.4	0.3	500~ 1200	100	33	0.0068	2SD826 EF×2	"	"	"	"





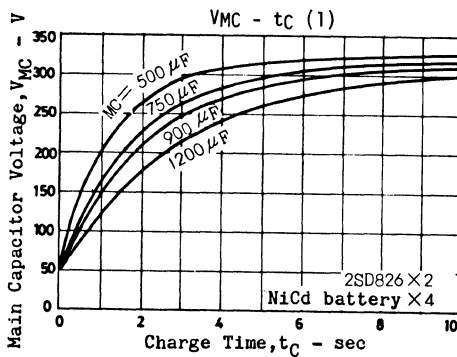
P: 0.6 ϕ 22 $\frac{3}{4}$ T

F: 0.23 ϕ 20 $3/4$ T

S: 0.08 ϕ 1390T

CORE: EE16

CORE: EE16



2SD863



2006A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB764

Voltage Regulator, Relay-Lamp Driver, Electrical Equipment Applications

Ⓔ575C

() : 2SB764

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)60	V
Collector to Emitter Voltage	V_{CEO}	(-)50	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_{C}	(-)1	A
Peak Collector Current	i_{cp}	(-)2	A
Collector Dissipation	P_{C}	0.9	W
Junction Temperature	T_{j}	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

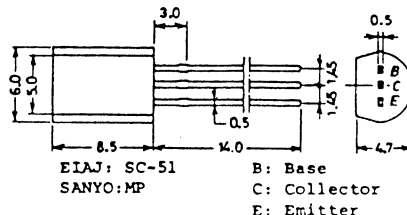
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{\text{CB}}=(-)50\text{V}, I_{\text{E}}=0$			(-)1	μA
Emitter Cutoff Current	I_{EBO}	$V_{\text{EB}}=(-)4\text{V}, I_{\text{C}}=0$			(-)1	μA
DC Current Gain	$h_{\text{FE}}(1)^*$	$V_{\text{CE}}=(-)2\text{V}, I_{\text{C}}=(-)50\text{mA}$	60*		320*	
	$h_{\text{FE}}(2)$	$V_{\text{CE}}=(-)2\text{V}, I_{\text{C}}=(-)1\text{A}$	30			
Gain Bandwidth Product	f_{T}	$V_{\text{CE}}=(-)10\text{V}, I_{\text{C}}=(-)50\text{mA}$		150		MHz
Output Capacitance	c_{ob}	$V_{\text{CE}}=(-)10\text{V}, f=1\text{MHz}$		(20)		pF
				12		pF
C-E Saturation Voltage	$V_{\text{CE(sat)}}$	$I_{\text{C}}=(-)500\text{mA}, I_{\text{B}}=(-)50\text{mA}$	(-0.2)	(-0.7)		V
			0.15	0.5		V
B-E Saturation Voltage	$V_{\text{BE(sat)}}$	$I_{\text{C}}=(-)500\text{mA}, I_{\text{B}}=(-)50\text{mA}$	(-)0.85	(-)1.2		V
C-B Breakdown Voltage	$V_{\text{(BR)CBO}}$	$I_{\text{C}}=(-)10\mu\text{A}, I_{\text{E}}=0$	(-)60			V
C-E Breakdown Voltage	$V_{\text{(BR)CEO}}$	$I_{\text{C}}=(-)1\text{mA}, R_{\text{BE}}=\infty$	(-)50			V
E-B Breakdown Voltage	$V_{\text{(BR)EBO}}$	$I_{\text{C}}=(-)10\mu\text{A}, I_{\text{C}}=0$	(-)5			V

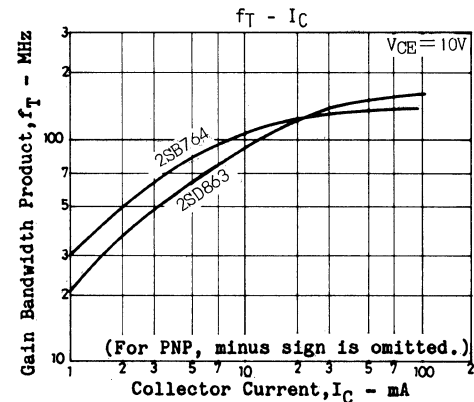
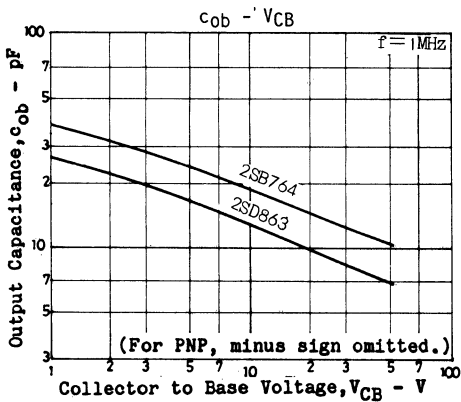
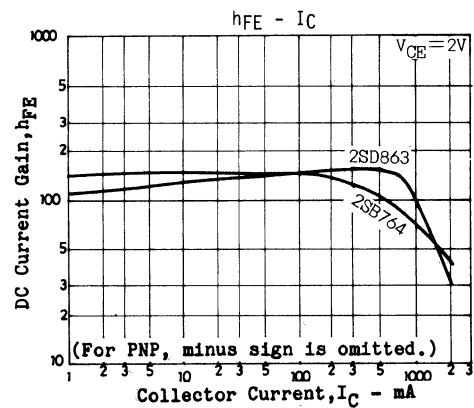
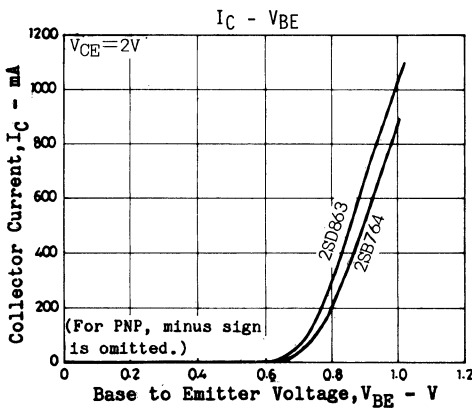
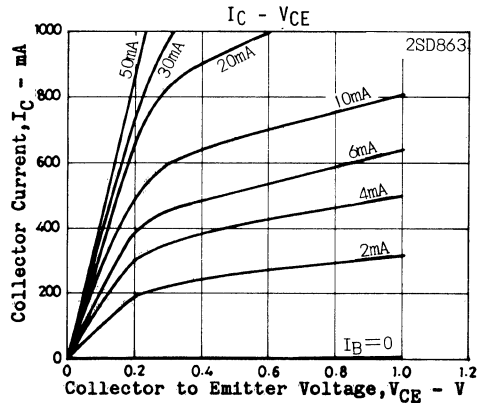
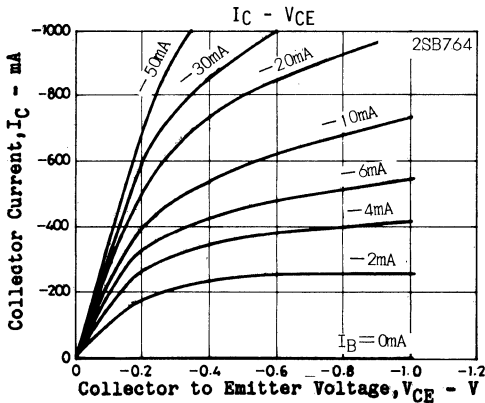
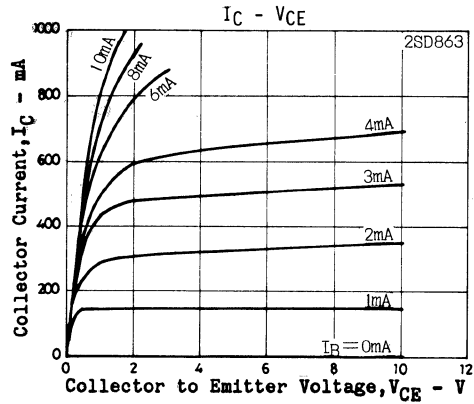
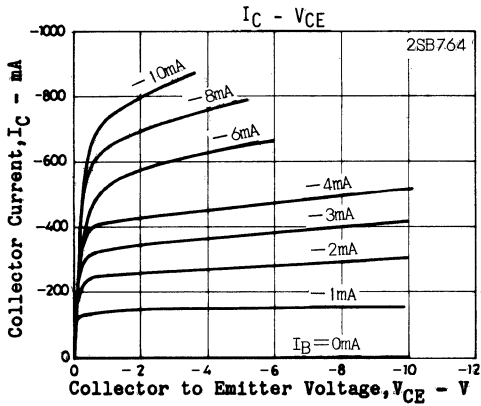
* The 2SB764/2SD863 are classified by 50mA h_{FE} as follows.

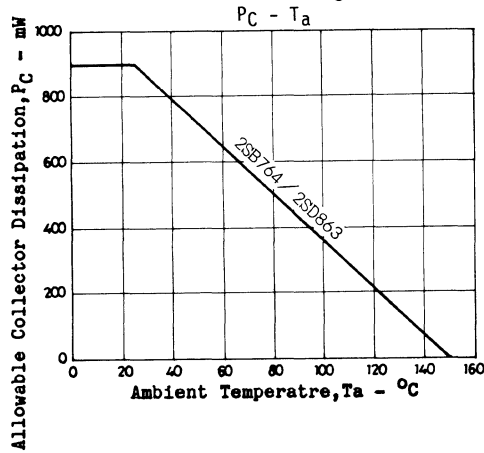
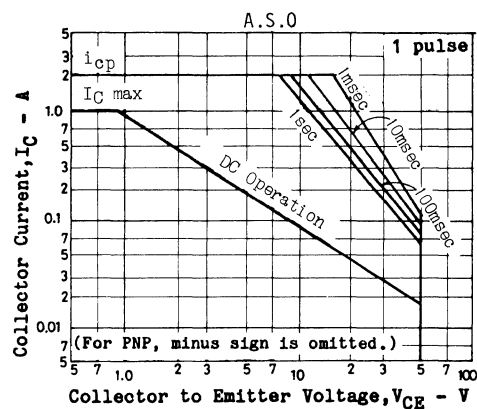
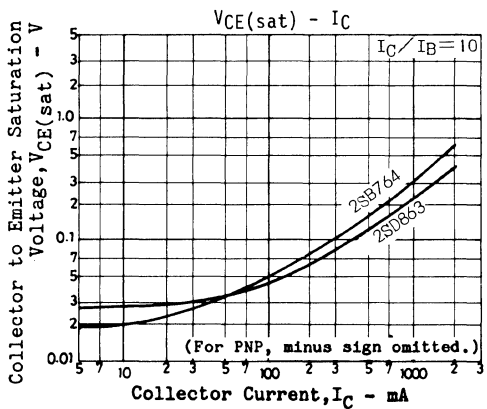
60	D	120	100	E	200	160	F	320
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Case Outline 2006A

(unit:mm)







2SD879



2003A

NPN Epitaxial Planar
Silicon Transistor

1.5V, 3V Strobe Applications

©550D

Features

- . In applications where two NiCd batteries are used to provide 2.4V, two 2SD879 transistors are used.
- . The charge time is approximately 1 second faster than that of germanium transistors.
- . Low collector saturation voltage $V_{CE(sat)}$ leads to low power dissipation, (TO-92, $P_C=750mW$).
- . Highly resistant to breakdown due to large current capacity.
- . Excellent hFE linearity from low current to high current.

Absolute Maximum Ratings at $T_a=25^{\circ}C$

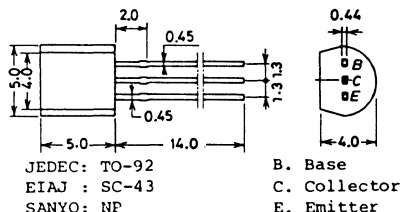
			unit
Collector to Base Voltage	V_{CBO}	30	V
Collector to Emitter Voltage	V_{CEX}	20	V
Collector to Emitter Voltage	V_{CEO}	10	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	3	A
Peak Collector current	i_{cp}	5	A
	100msec. 1 pulse		
Collector Dissipation	P_C	750	mW
Junction Temperature	T_j	150	$^{\circ}C$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}C$

Electrical Characteristics at $T_a=25^{\circ}C$

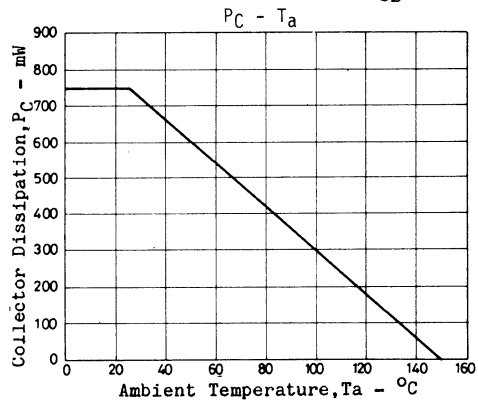
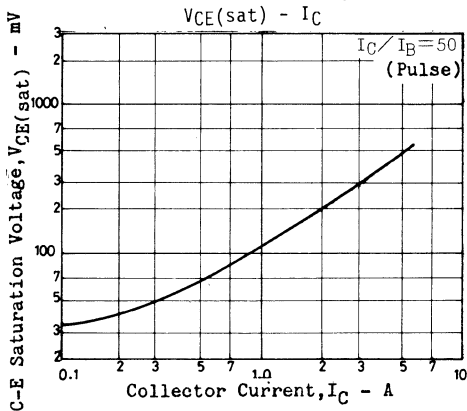
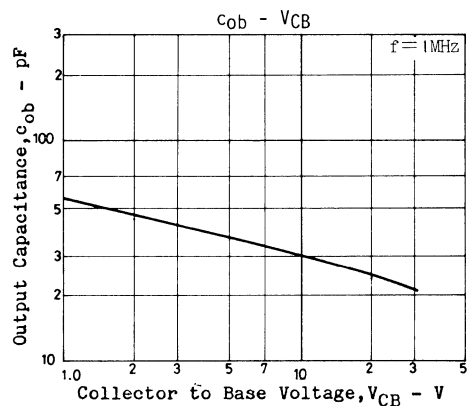
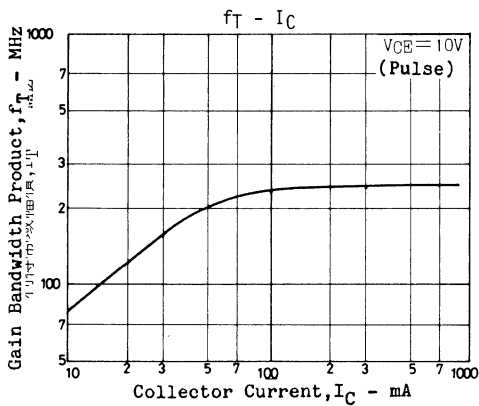
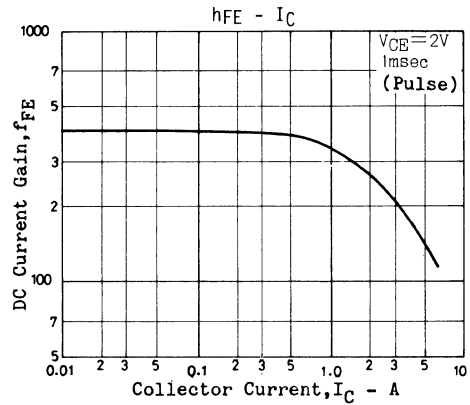
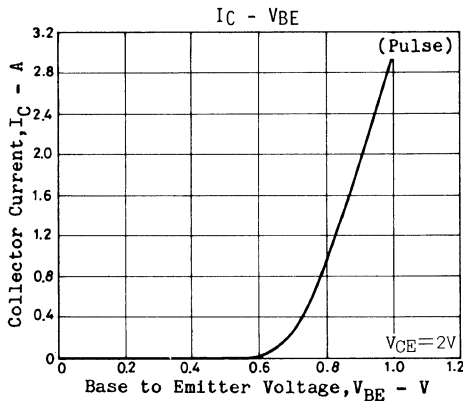
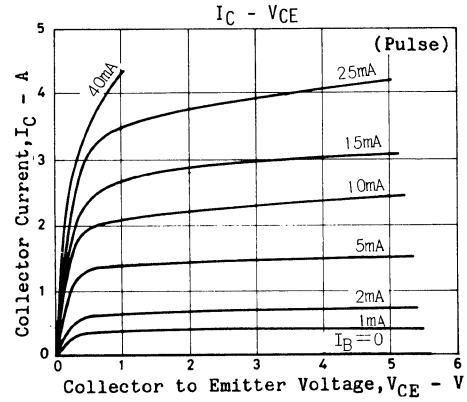
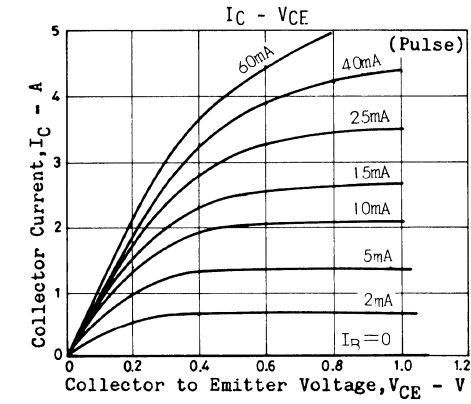
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=20V, I_E=0$			1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4V, I_C=0$			1.0	μA
DC Current Gain	hFE	$V_{CE}=2V, I_C=3A(Pulse)$	140	210		MHz
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=50mA$		200		pF
Output Capacitance	c_{ob}	$V_{CB}=10V, f=1MHz$		30		V
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=3A, I_B=60mA(Pulse)$		0.3	0.4	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10\mu A, I_E=0$	30			V
C-E Breakdown Voltage	$V_{(BR)CEX}$	$I_C=1mA, V_{BE}=3V$	20			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA, R_{BE}=\infty$	10			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=10\mu A, I_C=0$	6			V

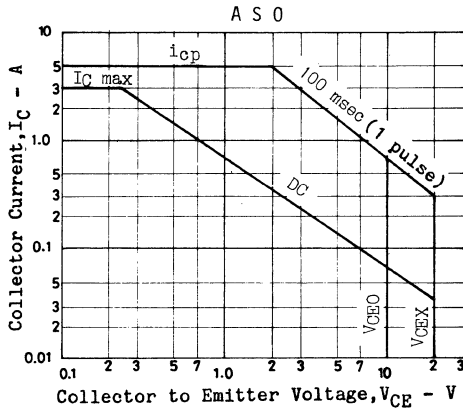
Case Outline 2003A

(unit:mm)

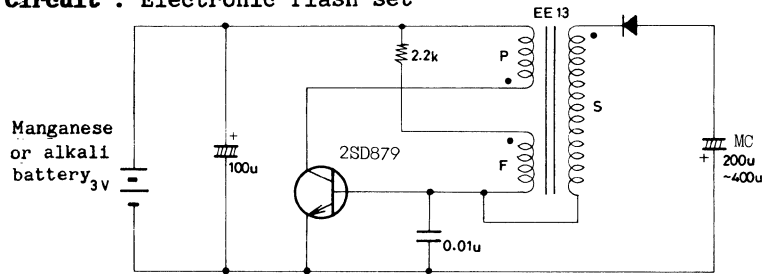


3075KI/5244KI, TS No.550-1/3

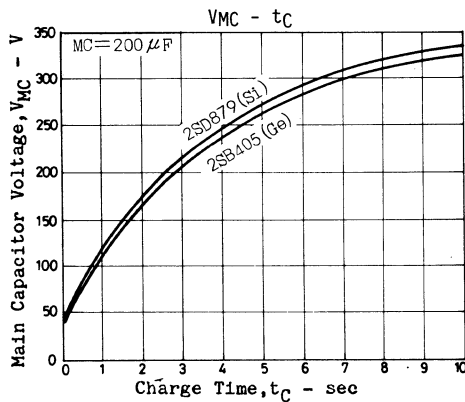
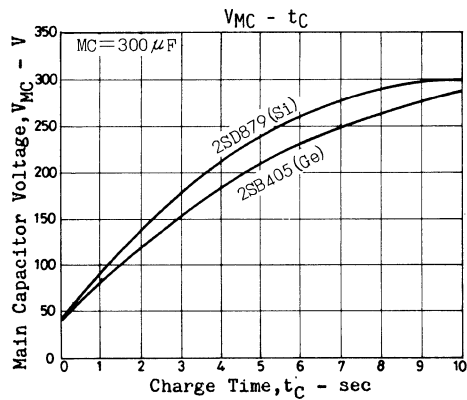
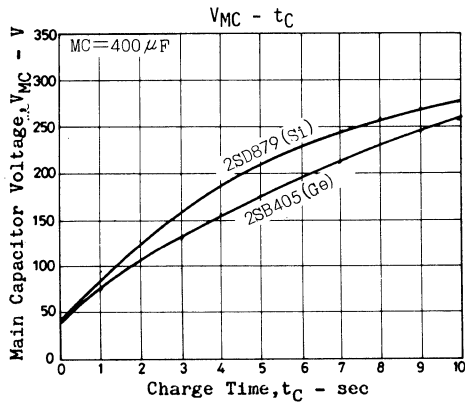




Sample Application Circuit : Electronic flash set



Core: EE13 Number of turns of transformer P : $0.55 \sqrt{10^3} \frac{3}{4} T$, S : $0.07 \sqrt{1350} T$
(Kijima Musen) F : $0.23 \sqrt{12^3} \frac{3}{4} T$



2SD894



2009

NPN Epitaxial Planar
Silicon Transistor

Driver Applications

©590A

Use

- Motor drive, Printer hummer drive, Relay drive, Voltage regulator controller.

Features

- High DC Current Gain (not less than 4000).
- Wide ASO.
- Low saturation voltage (1.5V max.).
- Large power rating ($P_C=10W$).

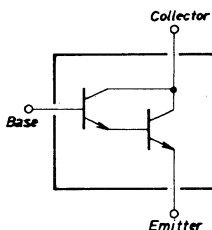
Absolute Maximum Ratings at $T_a=25^\circ C$

Solute Maximum Ratings at T _a =25°C			unit	
Collector to Base Voltage	V _{CBO}	30	V	
Collector to Emitter Voltage	V _{CEO}	25	V	
Emitter to Base Voltage	V _{EBO}	10	V	
Collector Current	I _C	1.5	A	
Peak Collector Current	i _{cp}	2.5	A	
Collector Dissipation	P _C	1	W	
	P _C	T _C =25°C	10	W
Junction Temperature	T _j	150	°C	
Storage Temperature	T _{stg}	-55 to +150	°C	

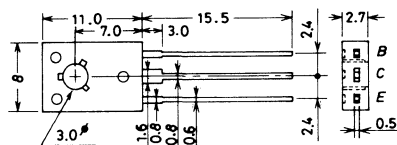
Electrical Characteristics at $T_a=25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=20V, I_E=0$			1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=8V, I_C=0$			1	μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=2V, I_C=500mA$	4000			
	$h_{FE}(2)$	$V_{CE}=2V, I_C=10mA$	3000			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=50mA$		120		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=600mA, I_B=0.15mA$			1.5	V
B-E Saturation voltage	$V_{BE(sat)}$	$I_C=600mA, I_B=0.15mA$			2.0	V
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C=10\mu A, I_E=0$	30			V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_C=1mA, R_{BE}=\infty$	25			V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E=10\mu A, I_C=0$	10			V

Equivalent Circuit

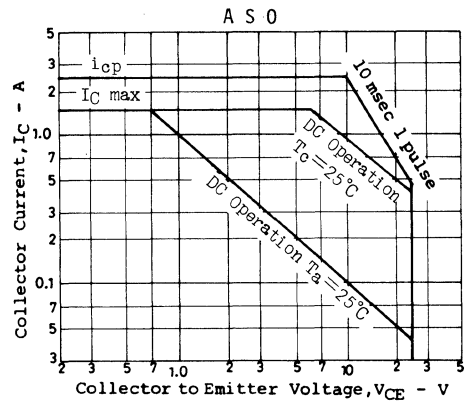
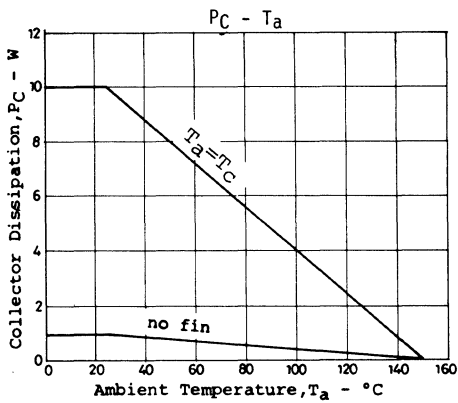
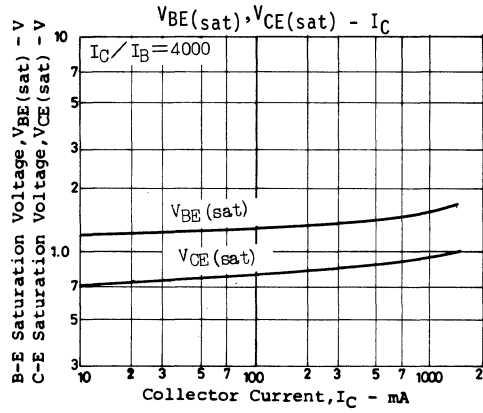
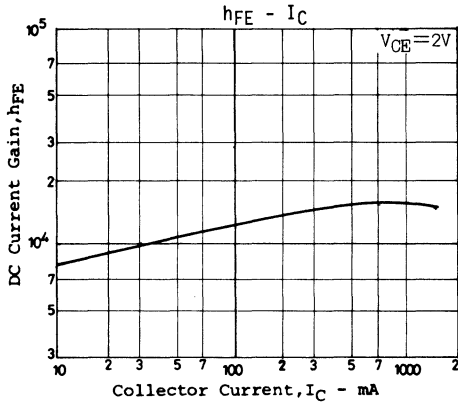


Case Outline 2009 (unit:mm)

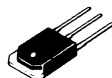


JEDEC: TO-126

B: Base
C: Collector
E: Emitter



2SD895



2022

NPN/PNP Planar
Silicon Transistors

2SB775

AF 35W Output Applications

©679D

Features

- Wide ASO because of on-chip ballast resistance.
- Capable of being mounted easily because of one-point fixing type plastic molded package (Interchangeable with TO-3).
- Large current capacity ($I_C=6A$)
- Highly resistant to breakdown.

(): 2SB775

Absolute Maximum Ratings at $T_a=25^{\circ}C$

			unit
Collector to Base Voltage	V_{CB0}	(-)100	V
Collector to Emitter Voltage	V_{CE0}	(-)85	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)6	A
Peak Collector Current	i_{cp}	(-)10	A
Collector Dissipation	P_C	60	W
Junction Temperature	T_j	150	$^{\circ}C$
Storage Temperature	T_{stg}	-40 to +150	$^{\circ}C$

$T_C=25^{\circ}C$

Electrical Characteristics at $T_a=25^{\circ}C$

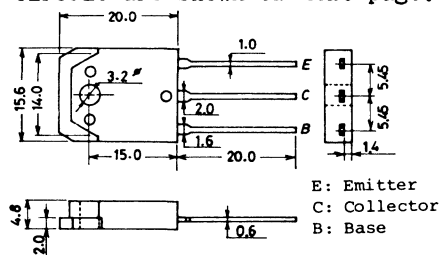
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40V, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$			(-)0.1	mA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)5V, I_C=(-)1A$	60*		200*	
	$h_{FE}(2)$	$V_{CE}=(-)5V, I_C=(-)3A$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)5V, I_C=(-)1A$		(18)		MHz
				15		
Output Capacitance	c_{ob}	$V_{CB}=(-)10V, f=1MHz$		160		pF
B-E Voltage	V_{BE}	$V_{CE}=(-)5V, I_C=(-)1A$			(-)1.5	V
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)4A, I_B=(-)0.4A$		(-1.4)	(-2.0)	V
				0.9	2.0	
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5mA, I_E=0$	(-)100			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)5mA, R_{BE}=\infty$	(-)85			V
		$I_C=(-)50mA, R_{BE}=\infty$	(-)85			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)5mA, I_C=0$	(-)6			V

* The 2SB775/2SD895 are classified by 1A h_{FE} as follows:

60	D	120	100	E	200
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.The switching time characteristic and test circuit are shown on next page.

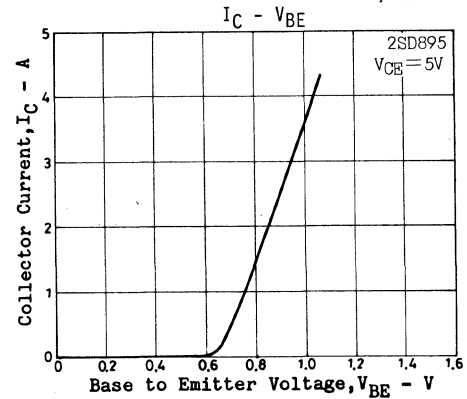
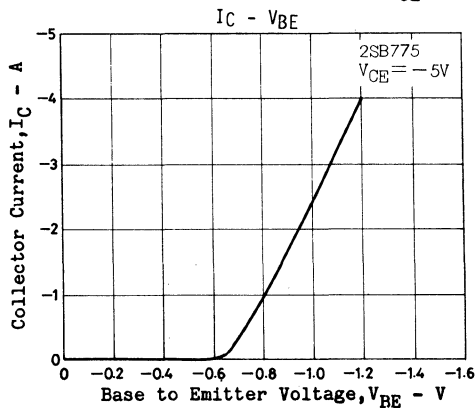
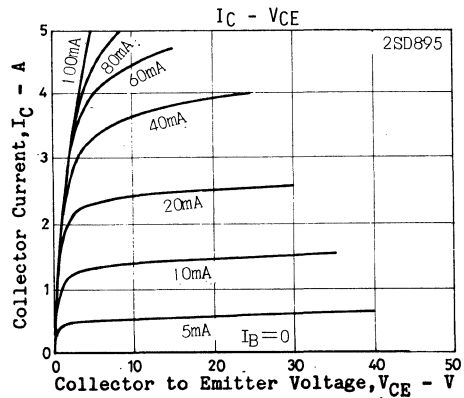
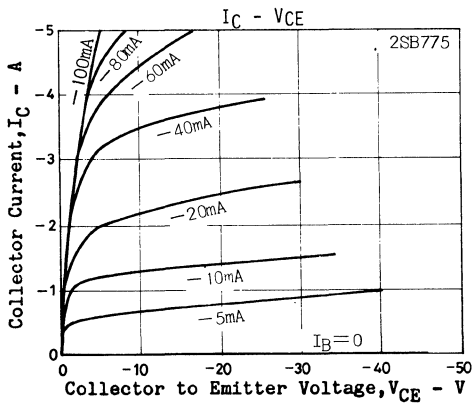
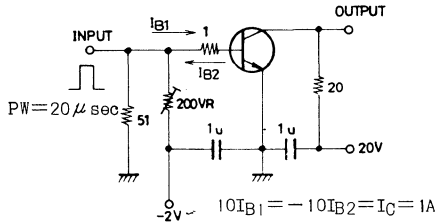
Case Outline 2022
(unit:mm)

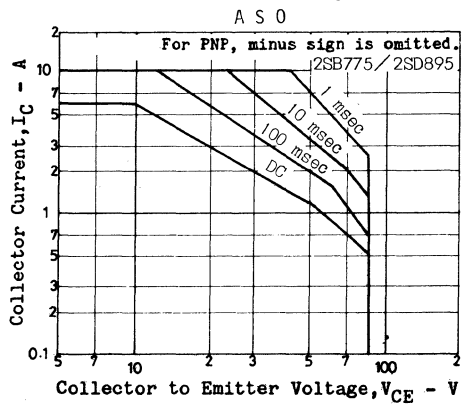
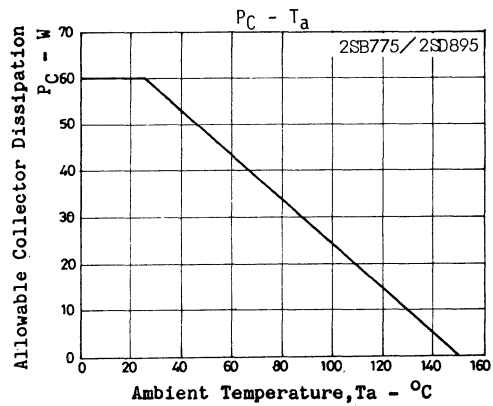
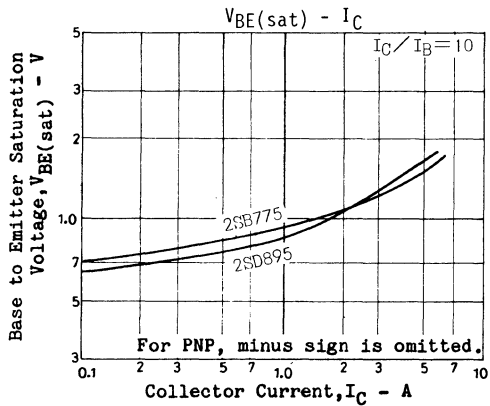
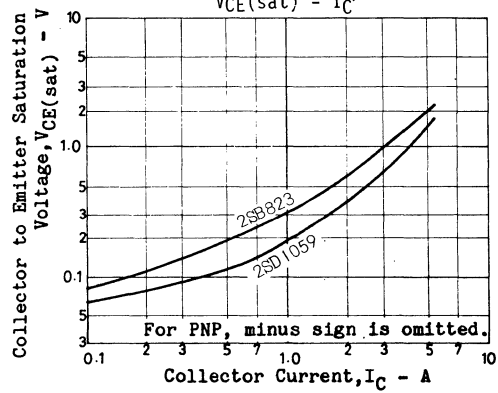
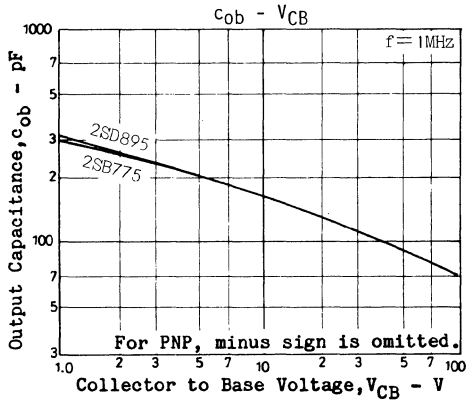
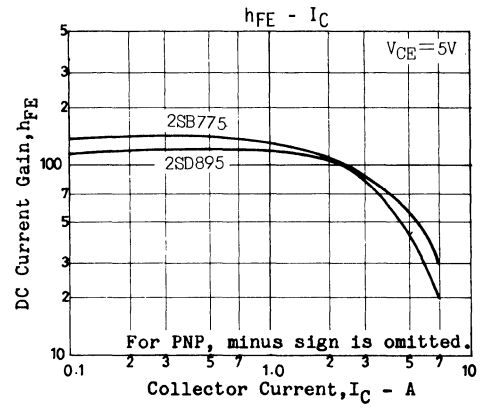
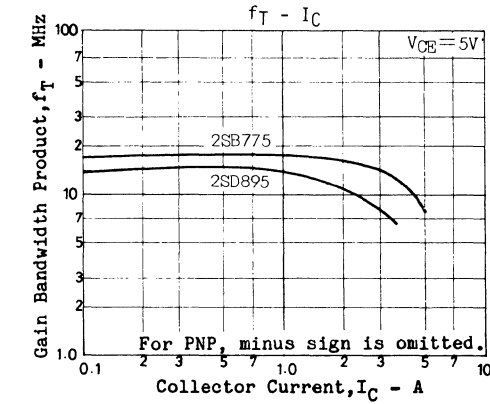


E: Emitter
C: Collector
B: Base

			min	typ	max	unit
Turn-on Time	t_{on}	at Test Circuit shown below		(0.12)		usec
				0.20		
Fall Time	t_f	"		(0.36)		usec
				0.82		
Storage Time	t_{stg}	"		(1.29)		usec
				3.88		

Switching Time Test Circuit





2SD896



2022

NPN/PNP Planar
Silicon Transistors

2SB776

AF 40W Output Applications

©678D

Features

- Capable of being mounted easily because of one-point fixing type plastic molded package (Interchangeable with T0-3).
- Wide ASO because of on-chip ballast resistance.
- Good dependence of f_T on current and excellent HF response.

(): 2SB776

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)120	V
Collector to Emitter Voltage	V_{CEO}	(-)100	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)7	A
Peak Collector Current	i_{cp}	(-)11	A
Collector Dissipation	P_C	70	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to +150	$^\circ\text{C}$

$T_C=25^\circ\text{C}$

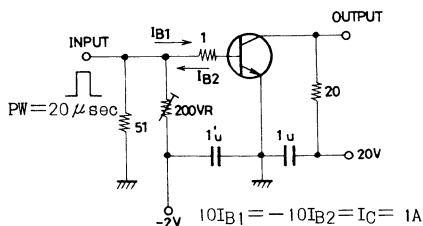
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	mA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$	60*		200*	
	$h_{FE}(2)$	$V_{CE}=(-)5\text{V}, I_C=(-)4\text{A}$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$		15		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(200)		pF
				140		
B-E Voltage	V_{BE}	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$			1.5	V
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)4\text{A}, I_B=(-)0.4\text{A}$		(0.9)		V
				0.6	2.0	
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)120			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)5\text{mA}, R_{BE}=\infty$	(-)100			V
		$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)100			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)5\text{mA}, I_C=0$	(-)6			V

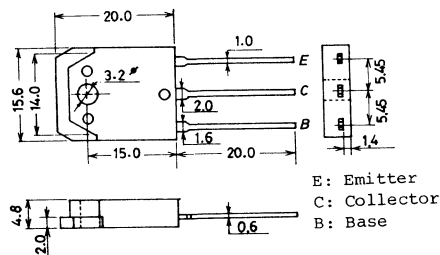
* 2SB776/2SD896 are classified by 1A h_{FE} as follows:

60	D	120	100	E	200
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Switching Time Test Circuit



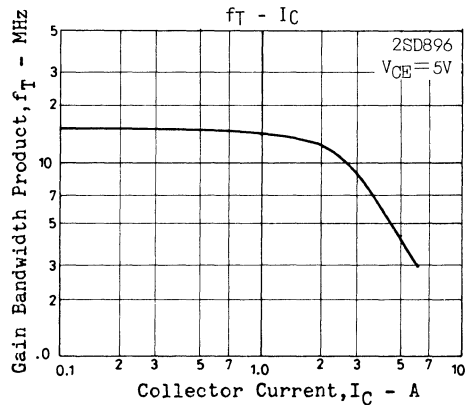
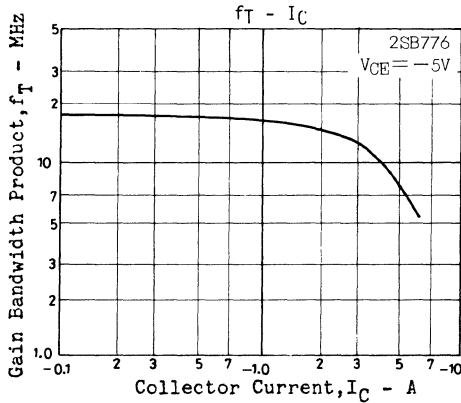
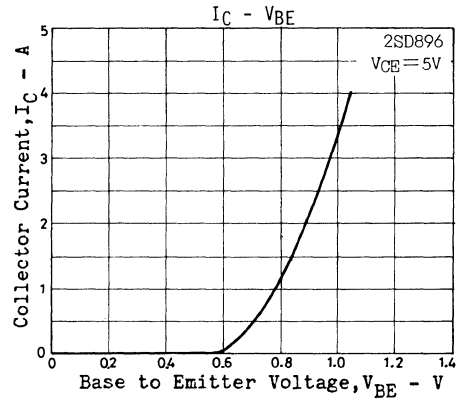
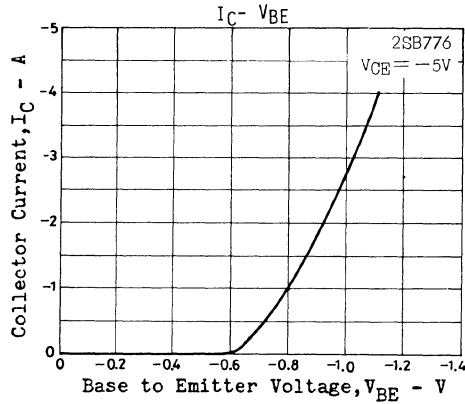
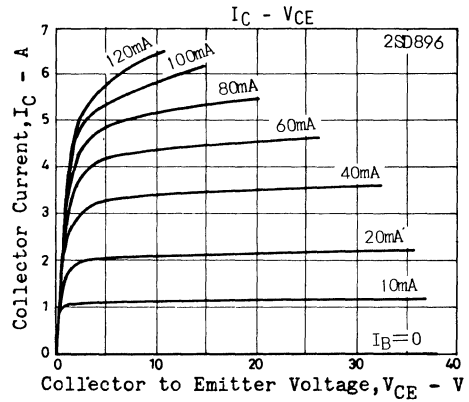
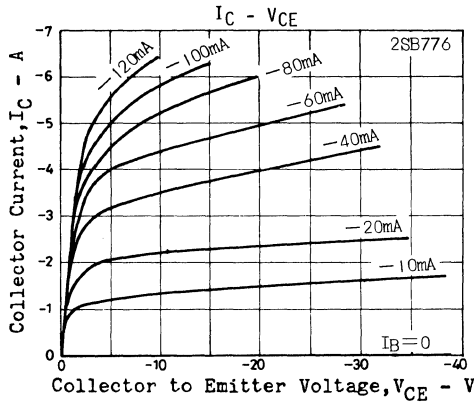
Case Outline 2022 (unit:mm)

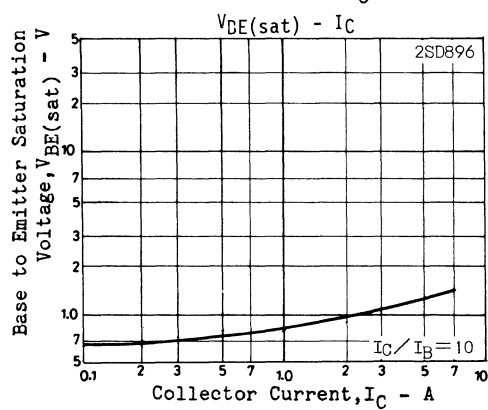
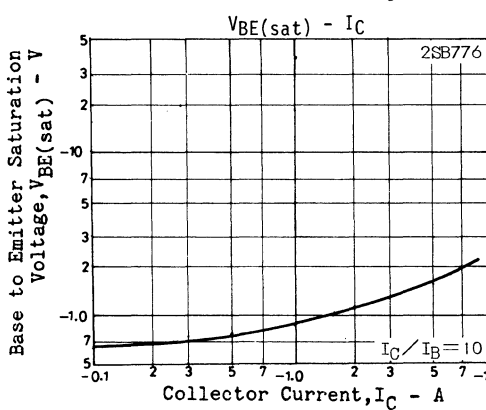
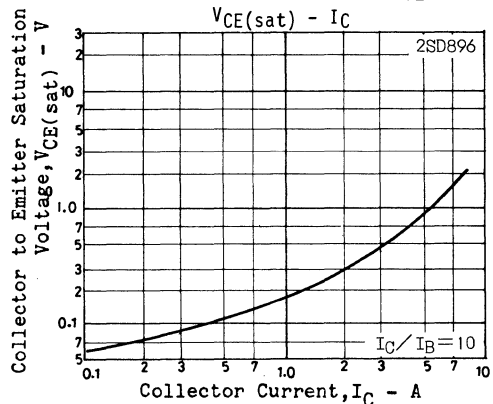
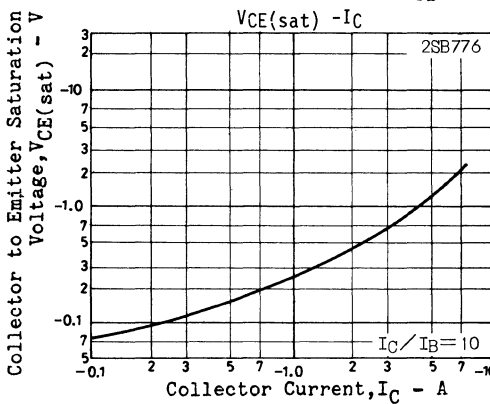
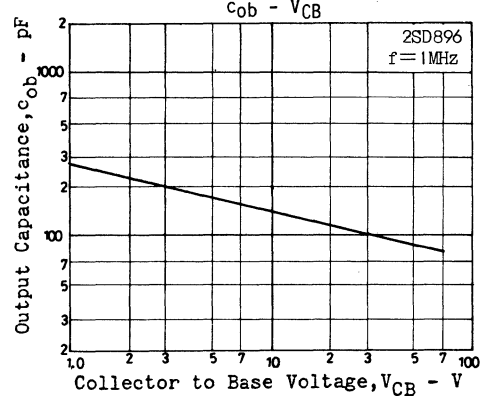
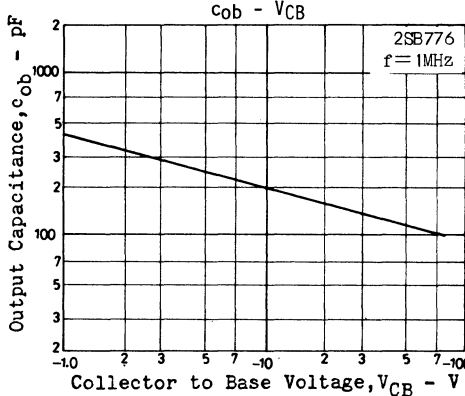
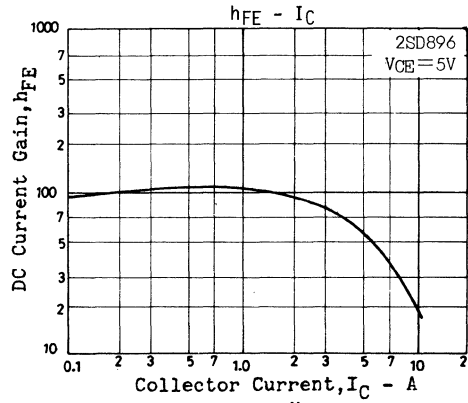
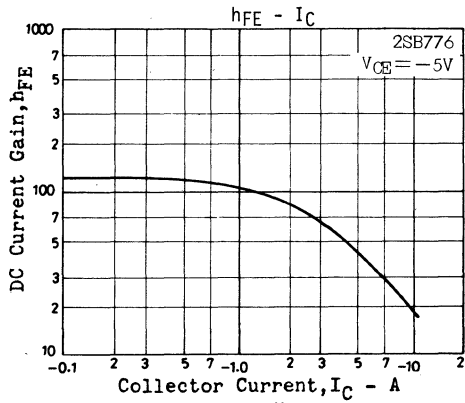


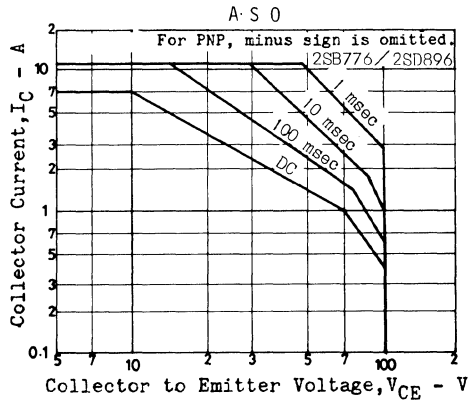
1115MY, TS No.678-1/4

2SD896/2SB776

			min	typ	max	unit
Turn-on Time	t_{on}	at test circuit shown below	(0.2)	0.2		usec
Fall Time	t_f	"	(0.3)	0.6		usec
Storage Time	t_{stg}	"	(1.2)	6.0		usec







2SD1012



2000B

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB808

3V, 4.5V High Current Amp Applications

©676B

(): 2SB808

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

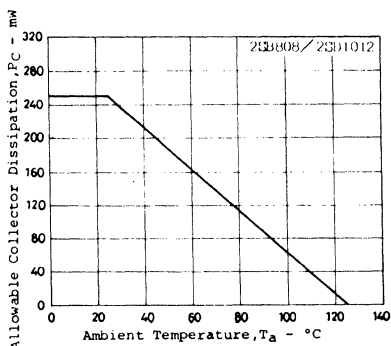
			unit
Collector to Base Voltage	V_{CB0}	(-) 20	V
Collector to Emitter Voltage	V_{CE0}	(-) 15	V
Emitter to Base Voltage	V_{EB0}	(-) 5	V
Collector Current	I_C	(-) 0.7	A
Peak Collector Current	i_{cp}	(-) 1.5	A
Collector Dissipation	P_C	250	mW
Junction Temperature	T_j	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +125	$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

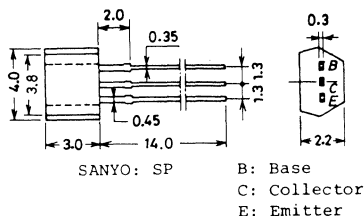
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)15\text{V}, I_E=0$		(-) 1.0		μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$		(-) 1.0		μA
DC Current Gain	$h_{FE(1)*}$	$V_{CE}=(-)2\text{V}, I_C=(-)50\text{mA}$	160*		960*	
	$h_{FE(2)}$	$V_{CE}=(-)2\text{V}, I_C=(-)500\text{mA}$	80			
		Pulse				
Gain Band-width Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		250		MHz
Common Base Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(13)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)1}$	$I_C=(-)5\text{mA}, I_B=(-)0.5\text{mA}$		(-15)	(-35)	mV
	$V_{CE(sat)2}$	$I_C=(-)100\text{mA}, I_B=(-)10\text{mA}$		(-60)	(-120)	mV
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)100\text{mA}, I_B=(-)10\text{mA}$		(-) 0.8	(-) 1.2	V
Collector to Base Breakdown Voltage	$V_{(BR) CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$		(-) 20		V
Collector to Emitter Breakdown Voltage	$V_{(BR) CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$		(-) 15		V
Emitter to Base Breakdown Voltage	$V_{(BR) EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$		(-) 5		V

* The 2SB808/2SD1012 are classified by 50mA h_{FE} as follows :

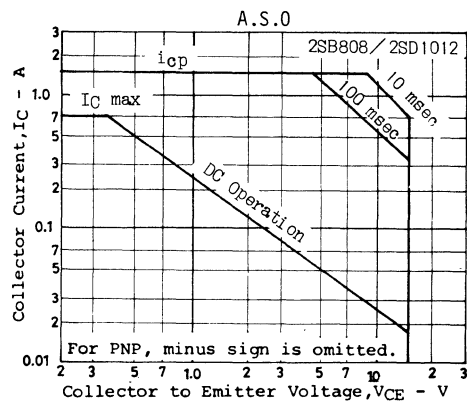
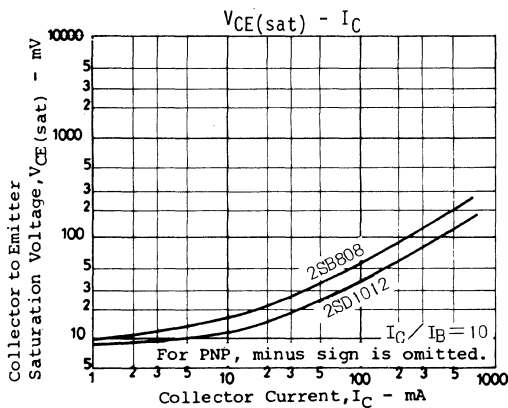
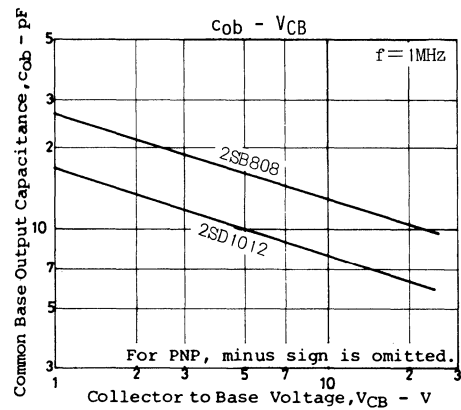
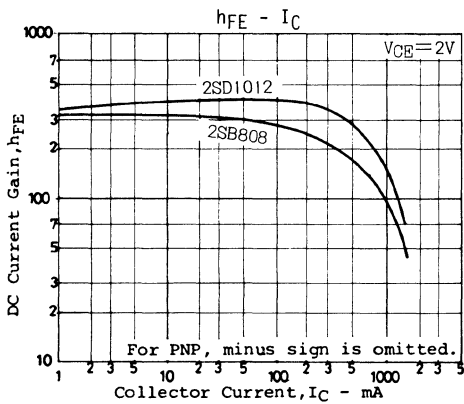
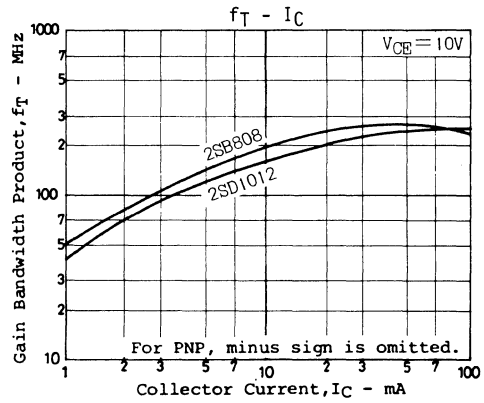
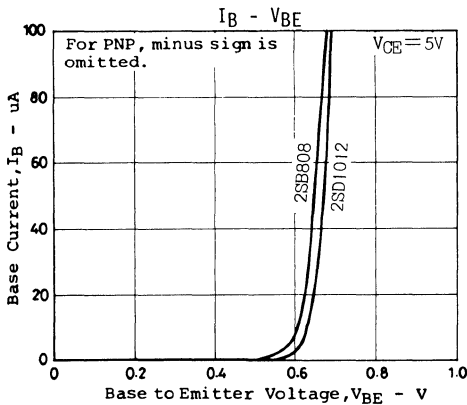
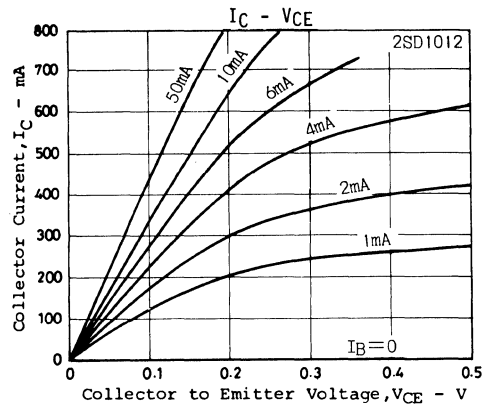
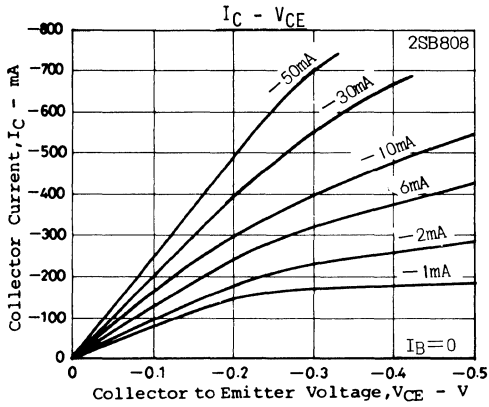
2SB808	160	F	320	280	G	560	
2SD1012	160	F	320	280	G	560	480 H 960



Case Outline 2000B
(unit:mm)



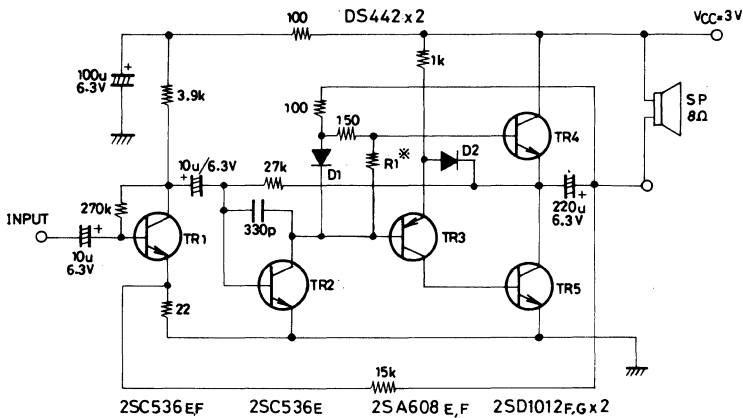
1115MY/1283KI, TS No.676-1/4



Sample Application Circuit : Low-voltage 3V(P_O 120mW) ITL-OTL power amp.

. Circuit configuration

For obtaining an output of more than 100mW, the middle-point voltage at the output stage and the collector voltage of the driver transistor must be $V_{CC}/2$. Therefore, the output stage is of quasi complementary configuration composed of npn/npn transistors. The phase is reversed by the 2SA608 and the middle-point voltage at the output stage and the collector voltage of the driver transistor are made to be $V_{CC}/2$ so that the output can be maximized.



R_1 : For controlling idle current

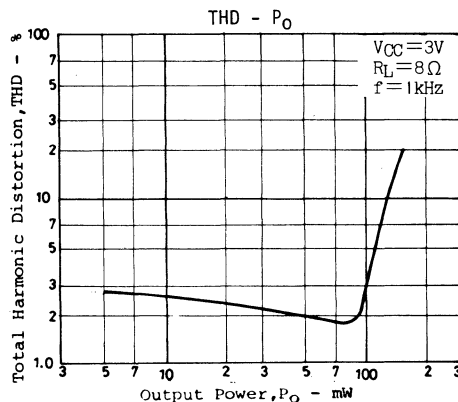
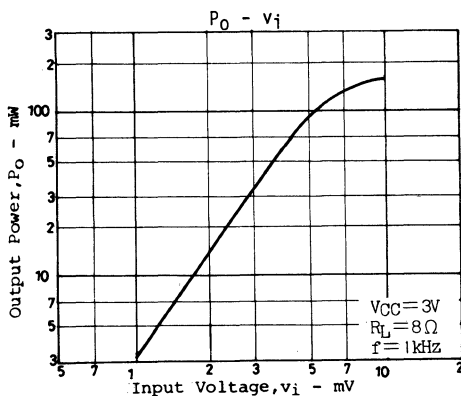
For $R_1 = 820\Omega$, use rank F for [TR4,5(2SD1012)].

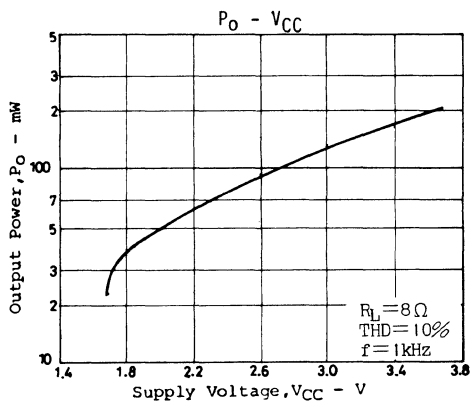
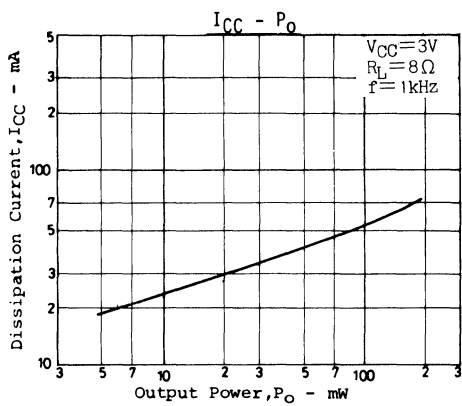
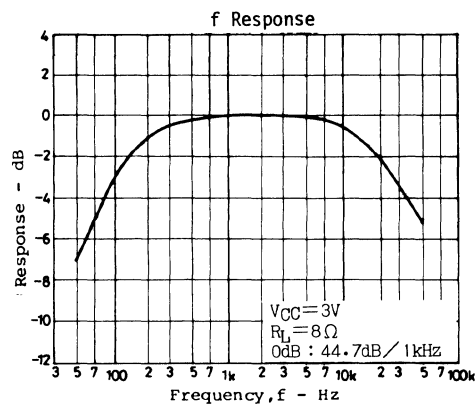
For $R_1 = 680\Omega$, use rank G for [TR4,5(2SD1012)].

. Main Specifications

Characteristic		f=400Hz	f=1kHz	unit
Current dissipation	Quiescent, Total current dissipation	11.0 to 15.5	11.0 to 15.5	mA
Output Power	THD=10%	120 to 125	127 to 130	mW
Voltage Gain	$P_O=10\text{mW}$	43.3 to 45.5	43.5 to 45.7	dB
Total harmonic distortion	$P_O=50\text{mW}$	1.4 to 2.6	1.3 to 2.5	%
Input resistance	$P_O=10\text{mW}$	10.4 to 20.5	11.0 to 21.0	kohm

Note : For above-mentioned h_{FE} rank.





2SD1046



2022

NPN/PNP Planar
Silicon Transistors**2SB816**

AF 50W Output Applications

E677C

Features

- Capable of being mounted easily because of one-point fixing type plastic molded package (Interchangeable with TO-3)
- Wide ASO because of built-in ballast resistance
- Good dependence of f_T on current and good HF characteristic

(): 2SB816

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)150	V
Collector to Emitter Voltage	V_{CEO}	(-)120	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)8	A
Peak Collector Current	i_{cp}	(-)12	A
Collector Dissipation	P_C	80	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to +150	$^\circ\text{C}$

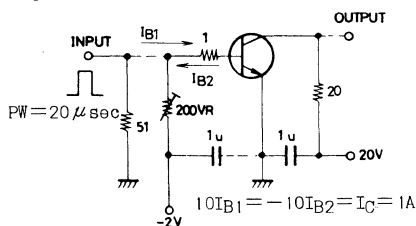
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	mA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$	60*		200*	
	$h_{FE}(2)$	$V_{CE}=(-)5\text{V}, I_C=(-)5\text{A}$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$		15		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(220)		pF
				160		
Base to Emitter Voltage	V_{BE}	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$			1.5	V
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{A}, I_B=(-)0.5\text{A}$		1.0	2.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)150			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)5\text{mA}, R_{BE}=\infty$	(-)120			V
		$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)120			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)5\text{mA}, I_C=0$	(-)6			V
Turn-on Time	t_{on}	At specified	(0.22)	0.22		usec
Fall Time	t_f	test circuit	(0.37)	1.02		usec
Storage Time	t_{stg}		(0.93)	6.66		usec

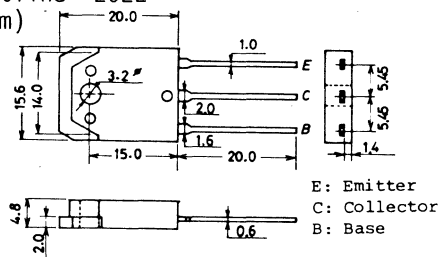
* The 2SB816/2SD1046 are classified by 1A h_{FE} as follows:

60	D	120	100	E	200
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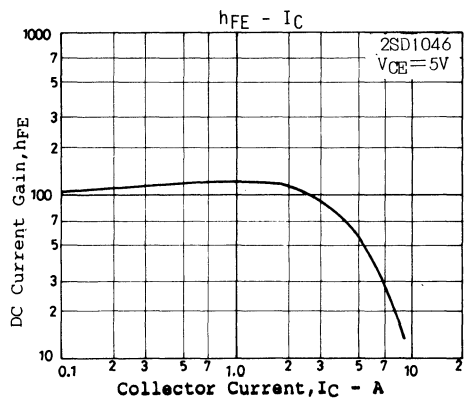
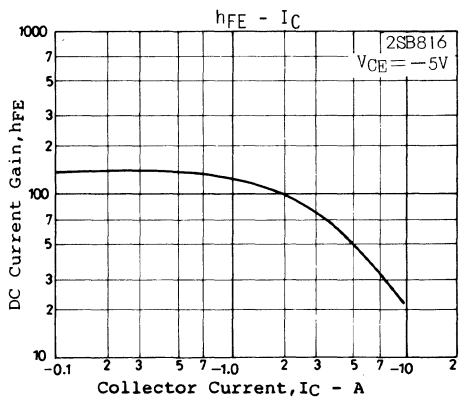
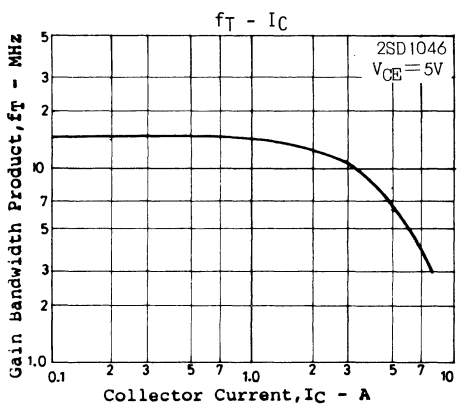
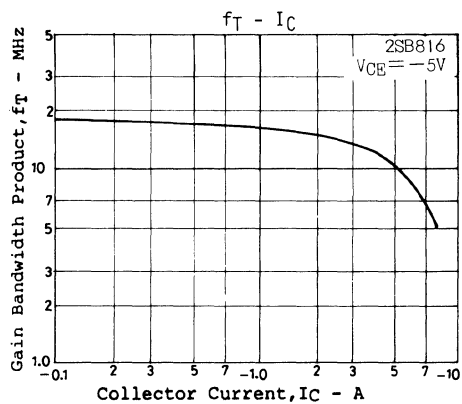
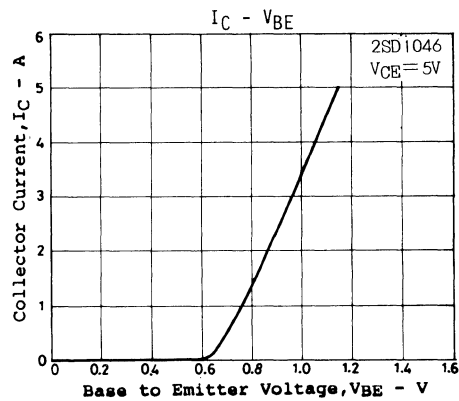
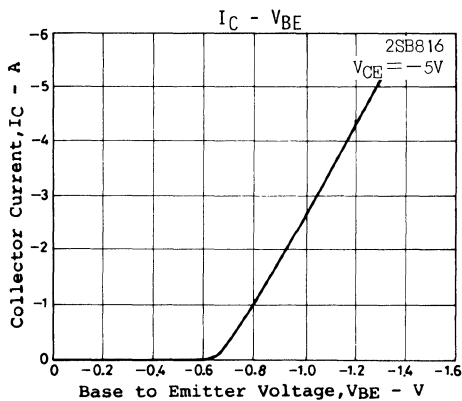
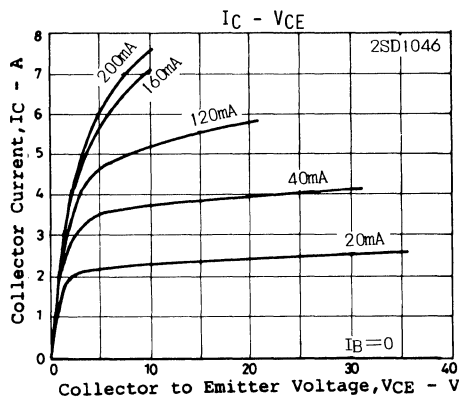
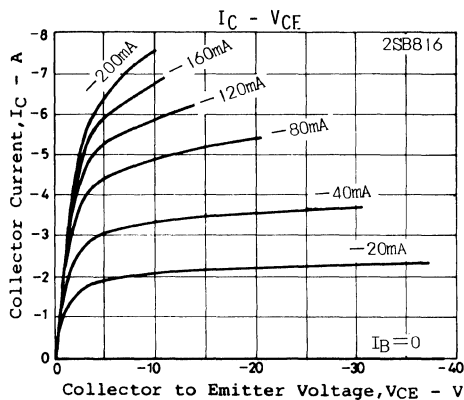
Switching Time Test Circuit

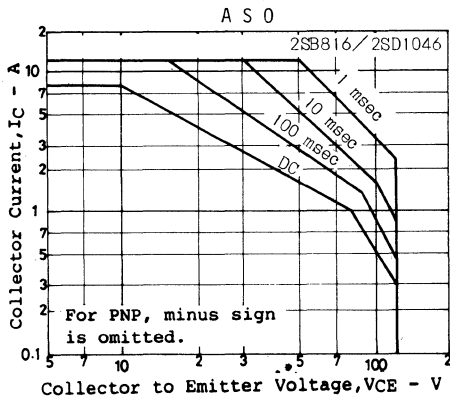
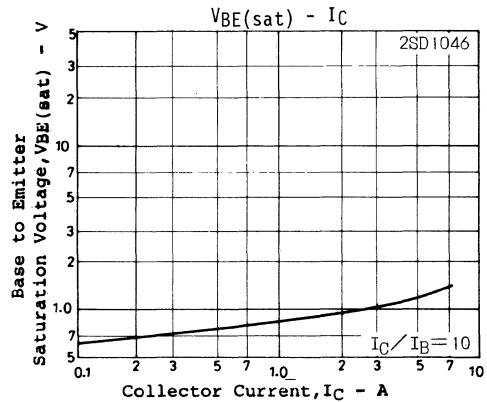
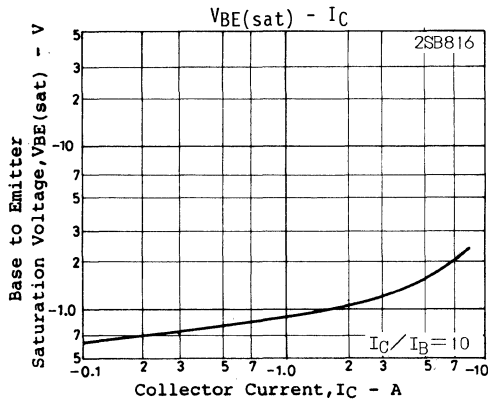
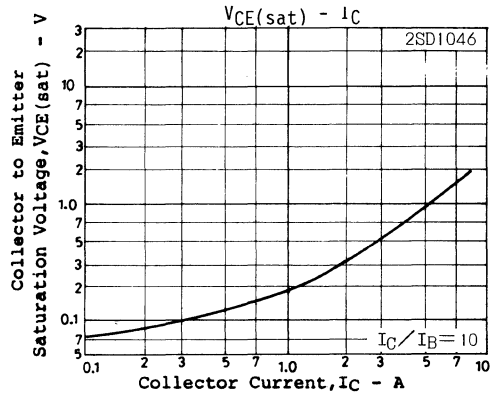
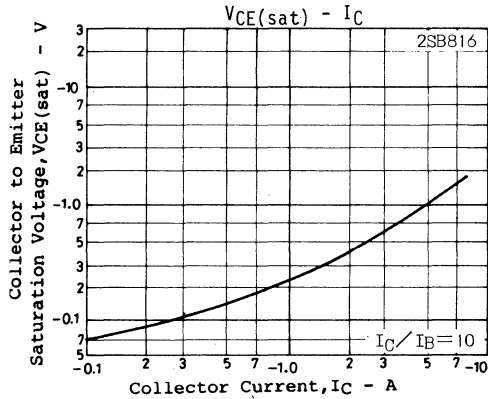
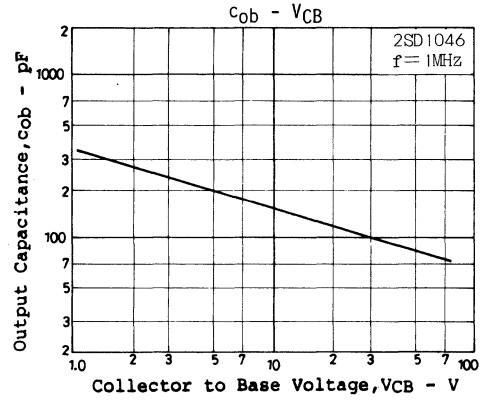
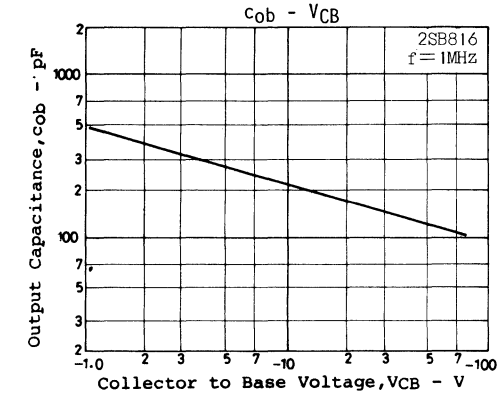


Case Outline 2022 (unir:mm)

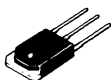


6284KI, MT No.677-1/3





2SD1047



2022

NPN/PNP Planar
Silicon Transistors

2SB817

AF 60W Output Applications

Ⓔ680D

Features

- Capable of being mounted easily because of one-point fixing type plastic molded package (Interchangeable with TO-3)
- Wide ASO because of built-in ballast resistance
- Good dependence of f_T on current and good HF characteristic

(): 2SB817

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)160	V
Collector to Emitter Voltage	V_{CEO}	(-)140	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)12	A
Peak Collector Current	i_{cp}	(-)15	A
Collector Dissipation	P_C	$T_C=25^\circ\text{C}$ 100	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to +150	$^\circ\text{C}$

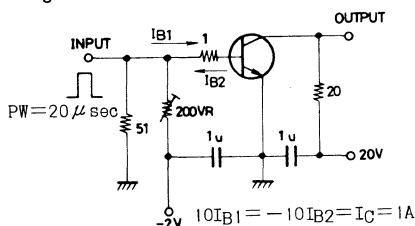
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	mA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$	60*		200*	
	$h_{FE}(2)$	$V_{CE}=(-)5\text{V}, I_C=(-)6\text{A}$	20			
Gain Bandwidth Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$		15		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		(300) 210		pF
Base to Emitter Voltage	V_{BE}	$V_{CE}=(-)5\text{V}, I_C=(-)1\text{A}$			1.5	V
Collector to Emitter	$V_{CE(sat)}$	$I_C=(-)5\text{A}, I_B=(-)0.5\text{A}$		(1.1)		
Saturation Voltage				0.6	2.5	V
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)160			V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_C=(-)5\text{mA}, R_{BE}=\infty$	(-)140			V
		$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)140			V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E=(-)5\text{mA}, I_C=0$	(-)6			V
Turn-on Time	t_{on}	At specified	(0.25)	0.26		usec
Fall Time	t_f	test circuit	(0.53)	0.68		usec
Storage Time	t_{stg}		(1.61)	6.88		usec

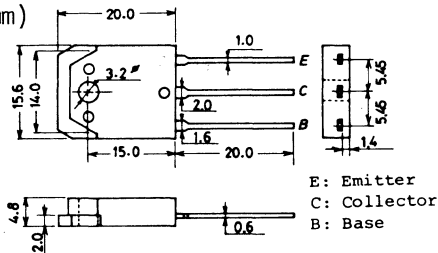
* The 2SB817/2SD1047 are classified by 1A h_{FE} as follows:

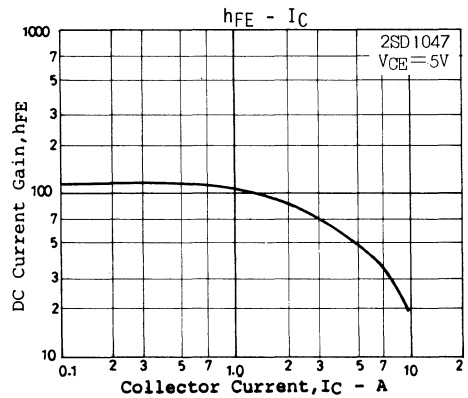
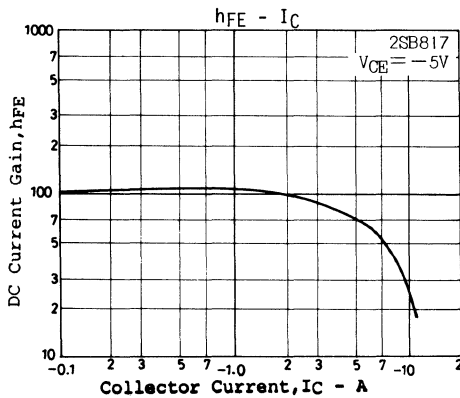
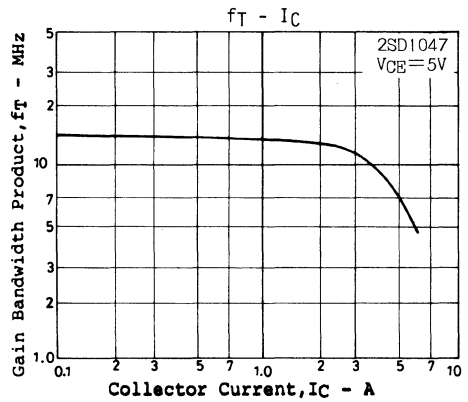
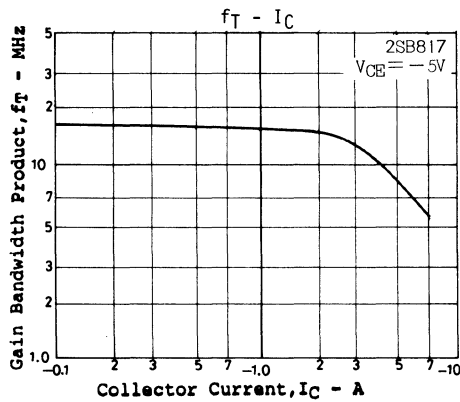
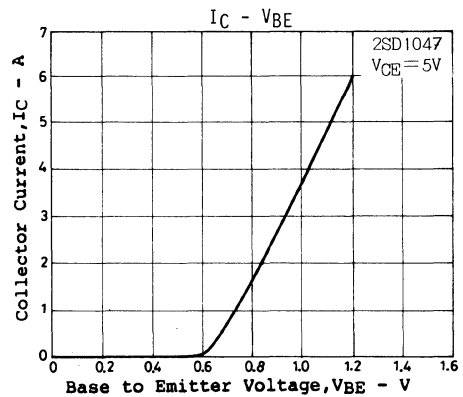
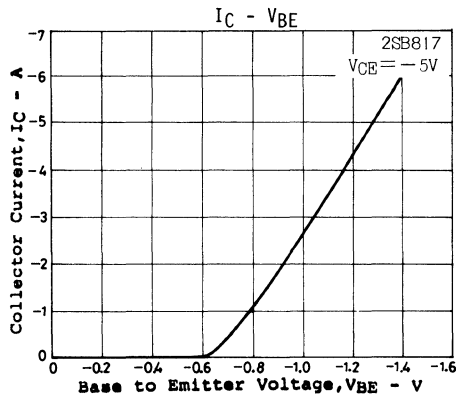
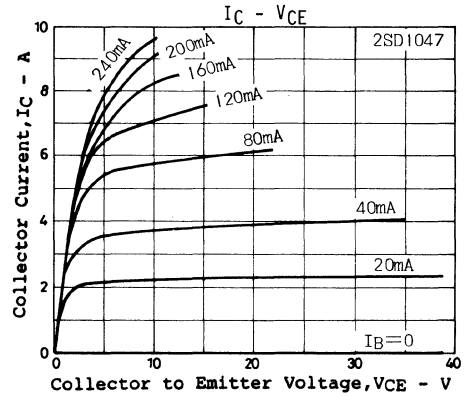
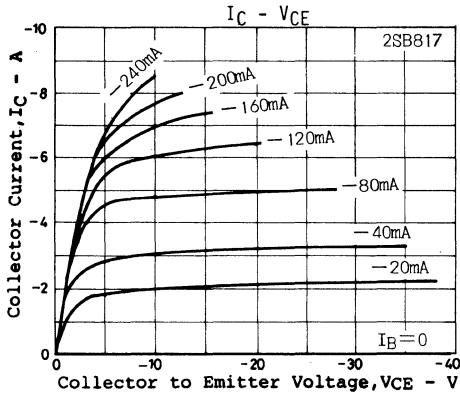
60	D	120	100	E	200
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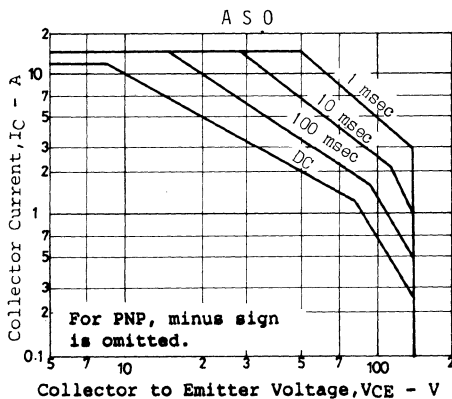
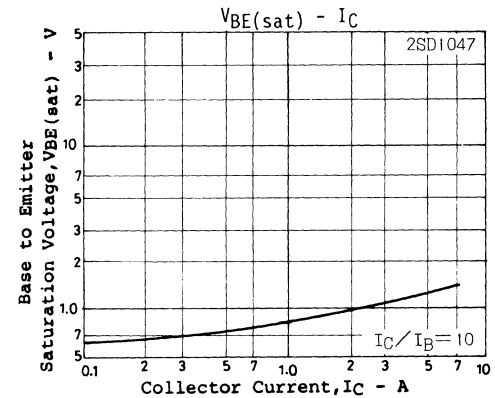
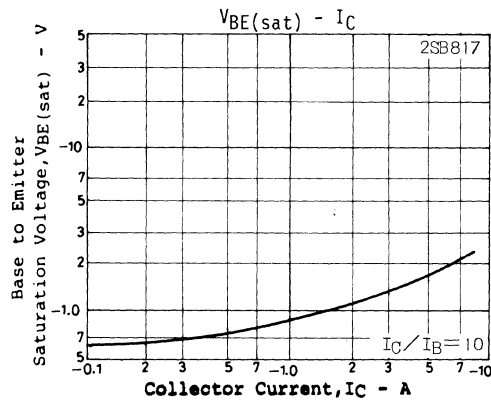
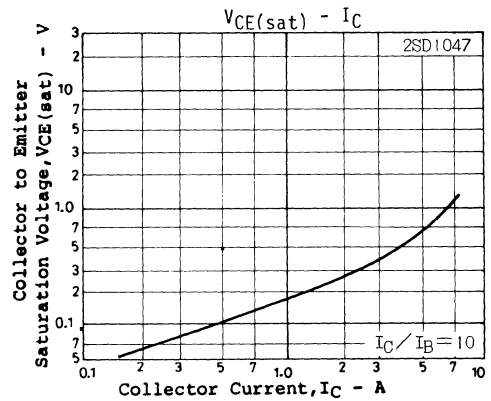
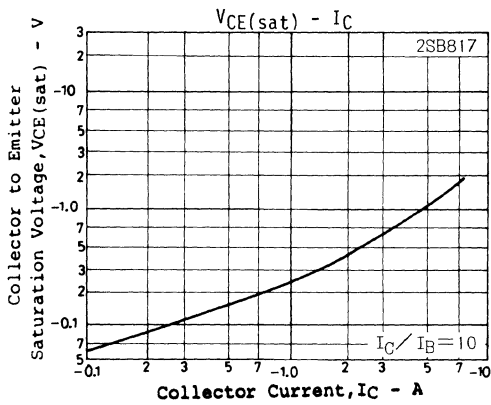
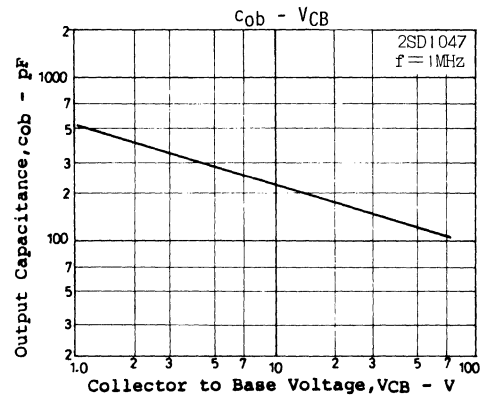
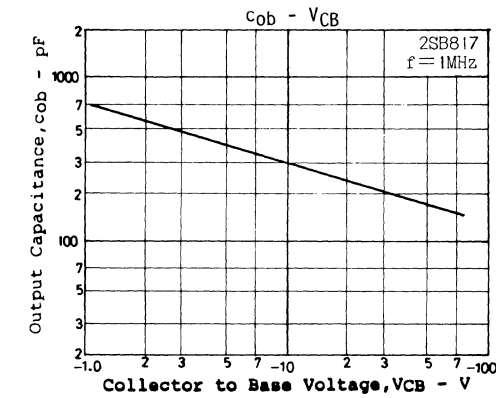
Switching Time Test Circuit



Case Outline 2022 (unit:mm)







2SD1048



2018

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB815

Low Frequency, General-Purpose Amp Applications

©694C

Features

- Very small package enabling compactness and slimness of sets
- Large current capacity ($I_C = 0.7A$) and low saturation voltage

(): 2SB815

Absolute Maximum Ratings/ $T_a = 25^\circ C$

			unit
Collector to base voltage	V_{CBO}	(-)20	V
Collector to emitter voltage	V_{CEO}	(-)15	V
Emitter to base voltage	V_{EBO}	(-)5	V
Collector current	I_C	(-)0.7	A
Peak collector current	i_{cp}	(-)1.5	A
Collector dissipation	P_C	200	mW
Junction temperature	T_j	125	$^\circ C$
Storage temperature	T_{stg}	-55 ~ +125	$^\circ C$

Electrical Characteristics/ $T_a = 25^\circ C$

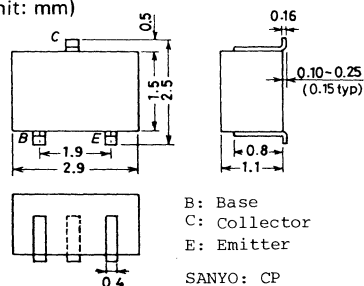
			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = (-)15V, I_E = 0$			(-)0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$			(-)0.1	μA
DC current gain	$h_{FE}(1)$	$V_{CE} = (-)2V, I_C = (-)50 mA$	200*		900*	
	$h_{FE}(2)$	$V_{CE} = (-)2V, I_C = (-)500 mA$	80			
Gain band-width product	f_T	$V_{CE} = (-)10V, I_C = (-)50 mA$		250		MHz
Output capacitance	C_{ob}	$V_{CB} = (-)10V, f = 1 MHz$		(13)		pF
				8		pF
Collector to emitter saturation voltage	$V_{CE(sat)}(1)$	$I_C = (-) 5 mA, I_B = (-) 0.5 mA$	(-15)	(-35)		mV
				10	25	mV
	$V_{CE(sat)}(2)$	$I_C = (-) 100 mA, I_B = (-) 10 mA$	(-60)	(-120)		mV
				30	80	mV

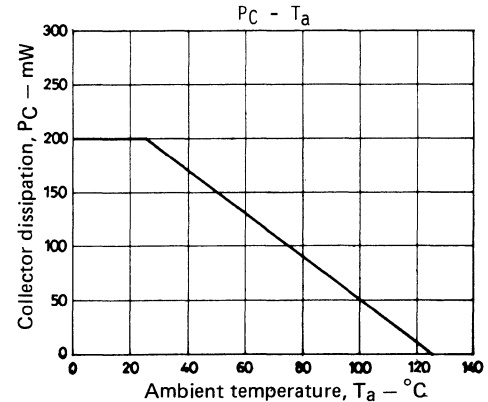
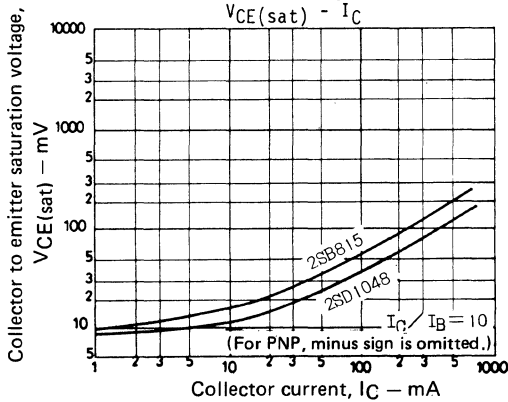
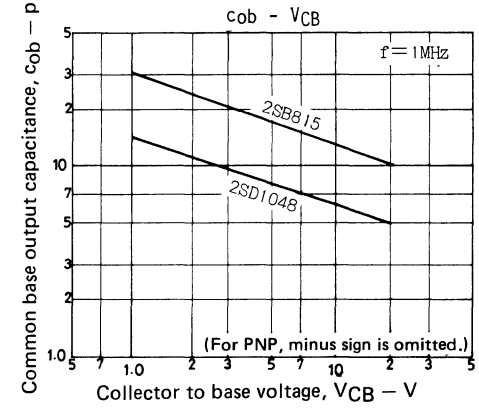
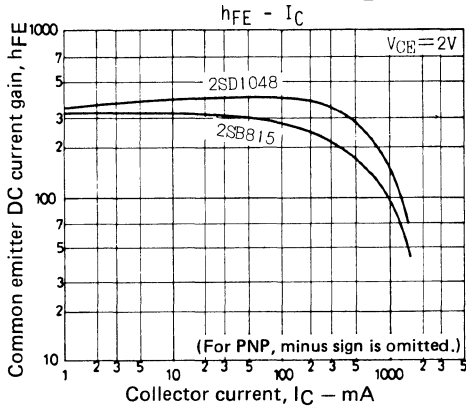
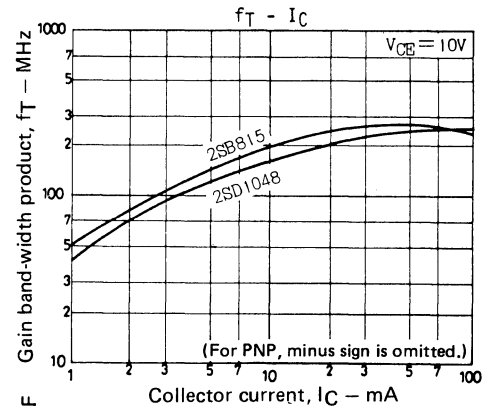
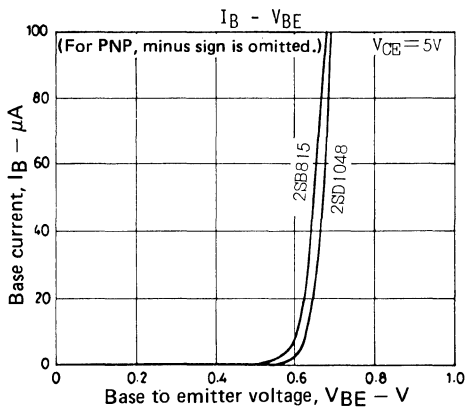
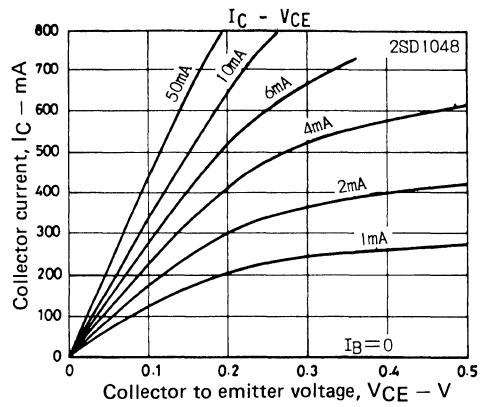
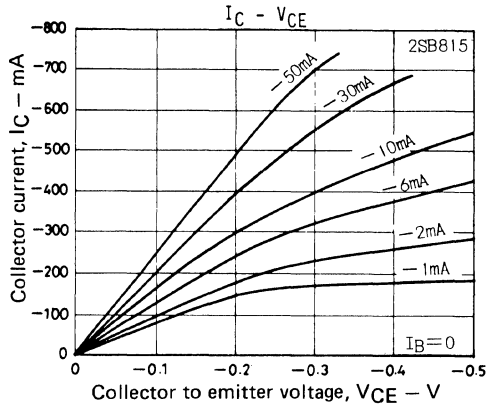
*: The 2SB815, 2SD1048 are classified by 50 mA h_{FE} as follows:

2SB815	200	B6	400	300	B7	600			
2SD1048	200	X6	400	300	X7	600	450	X8	900

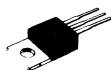
Case Outline 2018

(unit: mm)





2SD1060



2010A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB824

High Current Switching Applications

EC686G

APPLICATIONS

- Suitable for relay drivers, high-speed inverters, converters, and other general large-current switching

FEATURES

- Low collector-emitter saturation voltage: $V_{CE(sat)} = (-)0.4V$ max/ $I_C = (-)3A$, $I_B = (-)0.3A$

Values for 2SB824 shown in ()

ABSOLUTE MAXIMUM RATINGS/ $T_a = 25^\circ C$

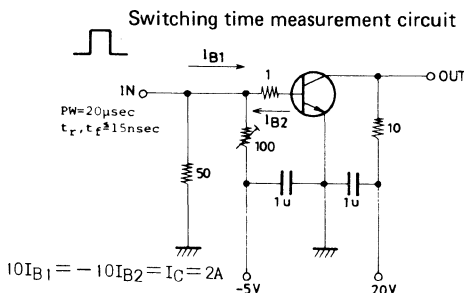
			unit
Collector to base voltage	V_{CBO}	(-)60	V
Collector to emitter voltage	V_{CEO}	(-)50	V
Emitter to base voltage	V_{EBO}	(-)6	V
Collector current	I_C	(-)5	A
Peak collector current	i_{cp}	(-)9	A
Allowable collector dissipation	P_C	$T_c = 25^\circ C$ 30	W
Junction temperature	T_j	150	$^\circ C$
Storage ambient temperature	T_{stg}	-55~+150	$^\circ C$

ELECTRICAL CHARACTERISTICS/ $T_a = 25^\circ C$

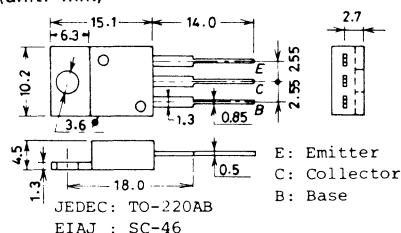
			min	typ	max	unit
Collector cut-off current	I_{CBO}	$V_{CB} = (-)40V, I_E = 0$			(-)0.1	mA
Emitter cut-off current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$			(-)0.1	mA
DC current gain	$h_{FE}(1)^*$	$V_{CE} = (-)2V, I_C = (-)1A$	70*		280*	
	$h_{FE}(2)$	$V_{CE} = (-)2V, I_C = (-)3A$	30			
Gain bandwidth product	f_T	$V_{CE} = (-)5V, I_C = (-)1A$		30		MHz
Output capacitance	c_{ob}	$V_{CB} = (-)10V, f = 1MHz$		100 (160)		pF pF
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C = (-)3A, I_B = (-)0.3A$			(-)0.4	V
Collector-base breakdown voltage	$V_{(BR)CBO}$	$I_C = (-)1mA, I_E = 0$	(-)60			V
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-)50			V
Emitter-base breakdown voltage	$V_{(BR)EBO}$	$I_E = (-)1mA, I_C = 0$	(-)6			V
Turn-on time	t_{on}	at the appointed circuit		0.1		μs
Storage time	t_{stg}	at the appointed circuit	(0.7)1.4			μs
Fall time	t_f	at the appointed circuit		0.2		μs

* 2SB824 and 2SD1060 are graded as follows by h_{FE} at 1A:

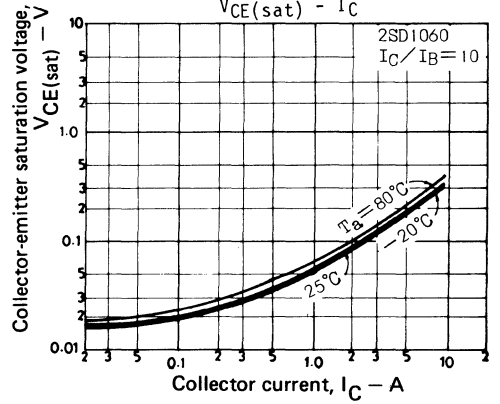
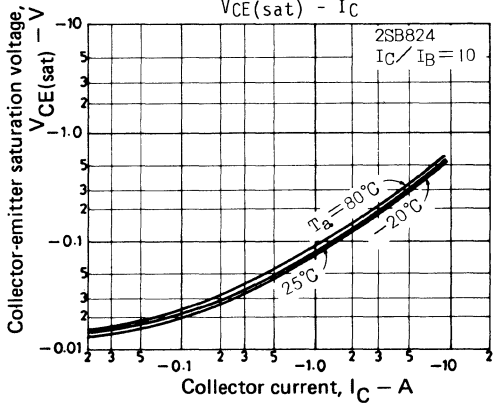
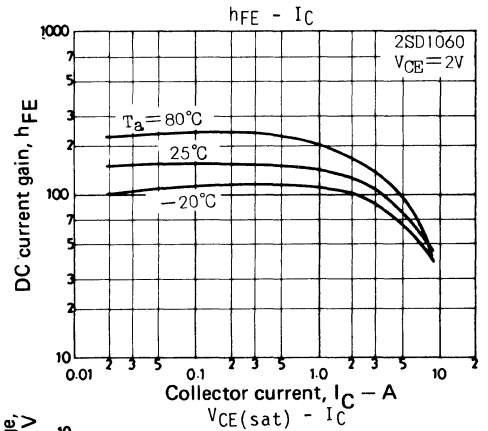
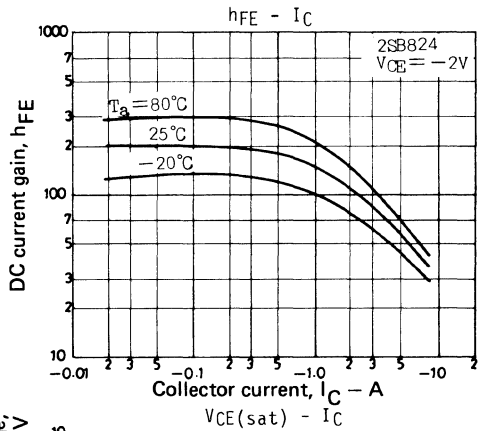
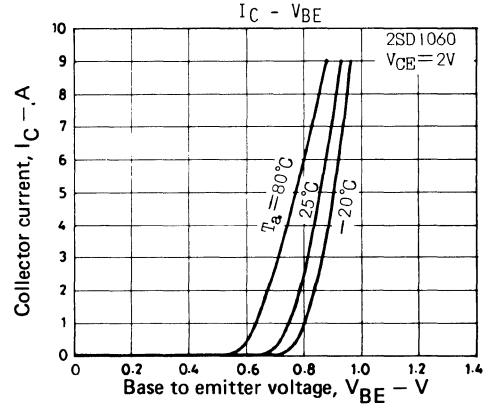
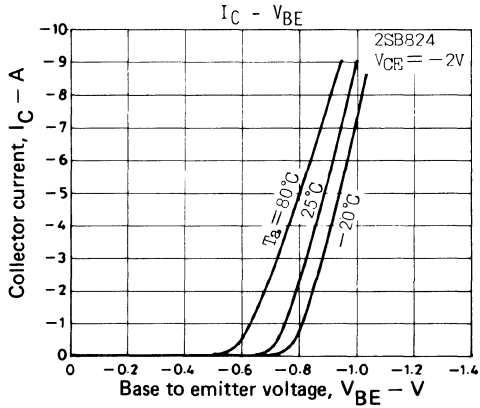
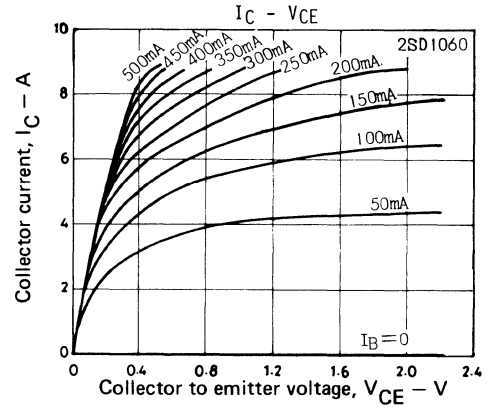
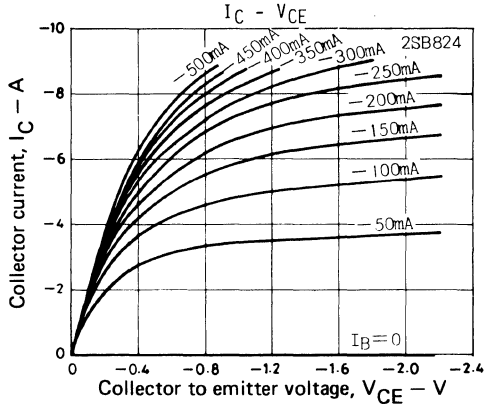
70	Q	140	100	R	200	140	S	280
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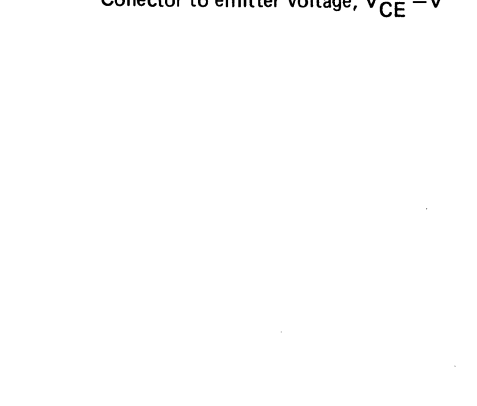
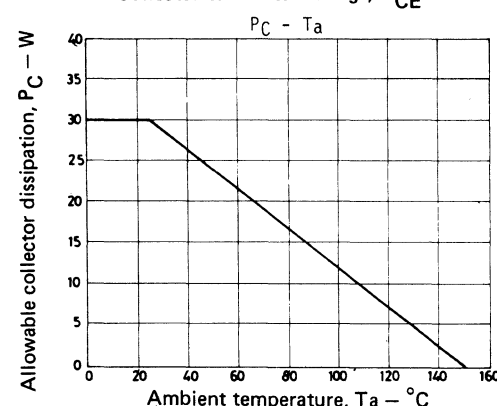
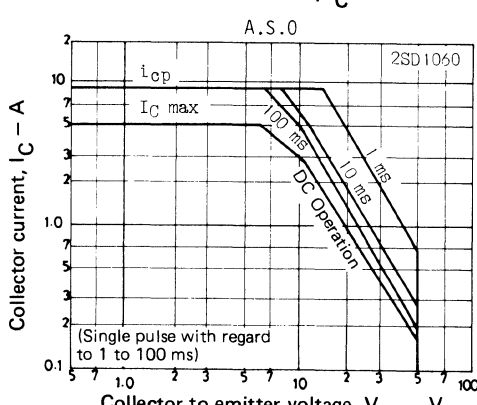
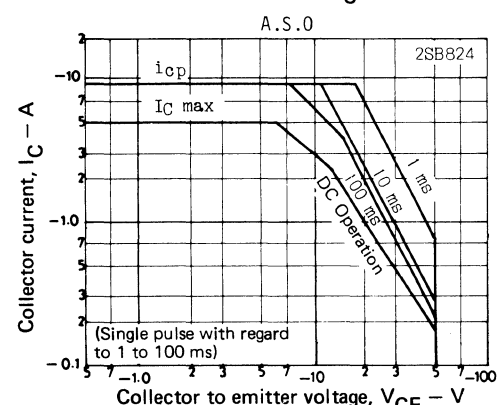
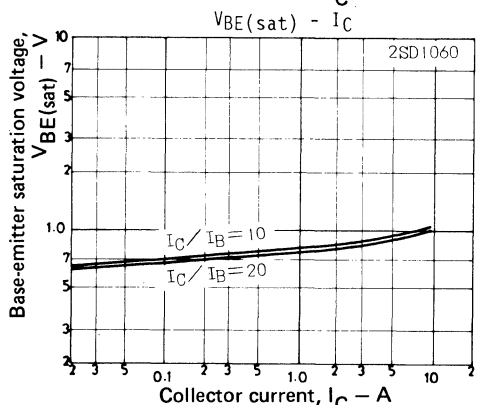
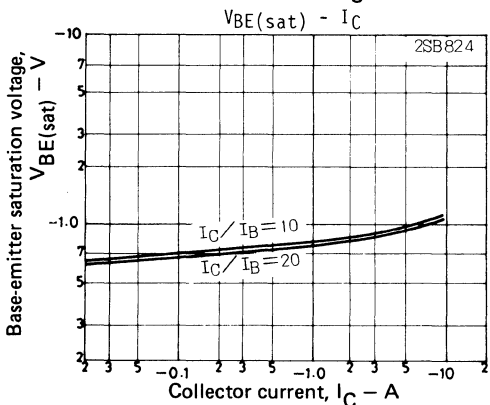
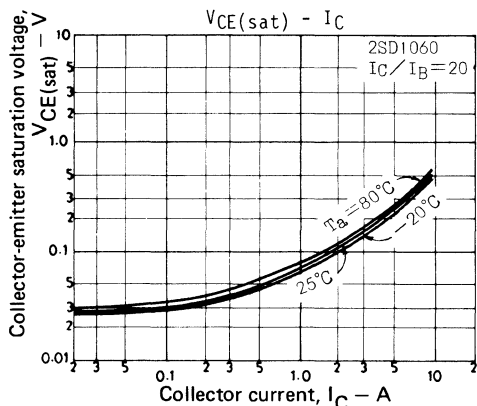
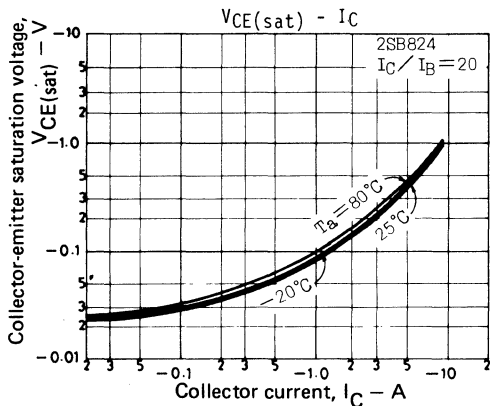


Case outline 2010A
(unit: mm)

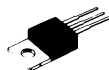


No. EC686G-1/3





2SD1061



2010A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB825

High Current Switching Applications

Ⓔ687E

Use : Universal high current switching as solenoid driving, high speed inverter and converter.

Features

- Low saturation voltage : $V_{CE(sat)} = (-) 0.4V$ max.
- Wide ASO.
- () 2SB825

Absolute Maximum Ratings at $T_a = 25^\circ C$

Collector to Base Voltage	V_{CBO}	(-) 60	V
Collector to Emitter Voltage	V_{CEO}	(-) 50	V
Emitter to Base Voltage	V_{EBO}	(-) 6	V
Collector Current	I_C	(-) 7	A
Peak Collector Current	i_{cp}	(-) 12	A
Collector Dissipation	P_C	40	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

$T_C = 25^\circ C$

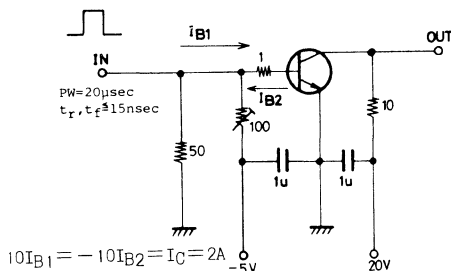
Electrical Characteristics at $T_a = 25^\circ C$

		min	typ	max	unit
Collector Cut off Current	I_{CBO}			(-) 0.1	mA
Emitter Cut off Current	I_{EBO}			(-) 0.1	mA
DC Current Gain	$h_{FE}(1) *$		70*	280*	
	$h_{FE}(2)$		30		
Gain Bandwidth Product	f_T		10		MHz
C-E Saturation Voltage	$V_{CE(sat)}$			(-) 0.4	V
C-B Breakdown Voltage	$V(BR)_{CBO}$			(-) 60	V
C-E Breakdown Voltage	$V(BR)_{CEO}$			(-) 50	V
E-B Breakdown Voltage	$V(BR)_{EBO}$			(-) 6	V
Turn-on Time	t_{on}		0.2		usec
Fall Time	t_f		(0.1) 0.3		usec
Storage Time	t_{stg}		(0.7) 0.9		usec

*2SB825, 2SD1061 are classified by 2V 1A h_{FE} as follows :

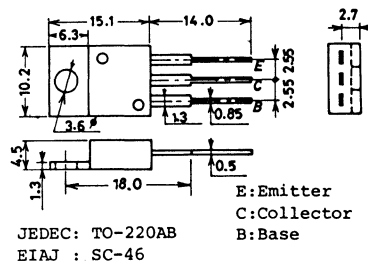
70	Q	140	100	R	200	140	S	280
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Switching Time Test Circuit

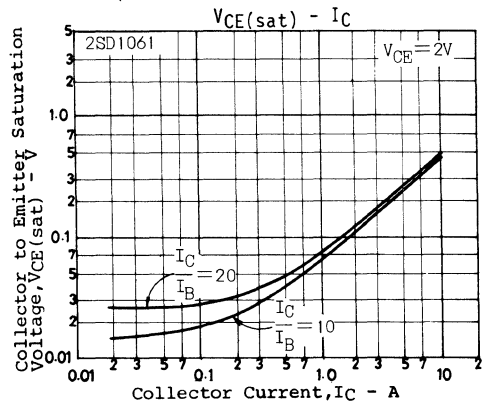
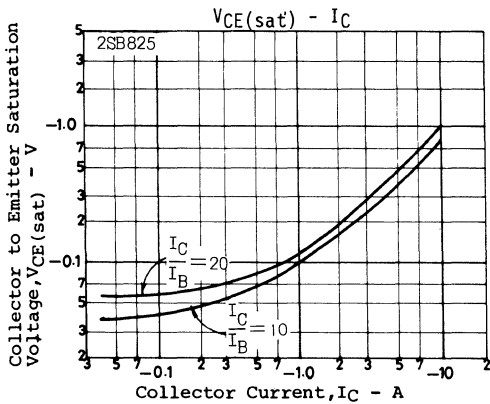
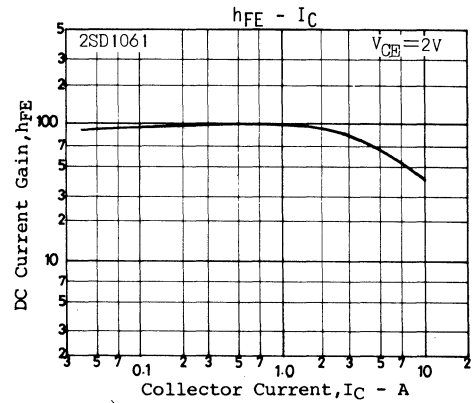
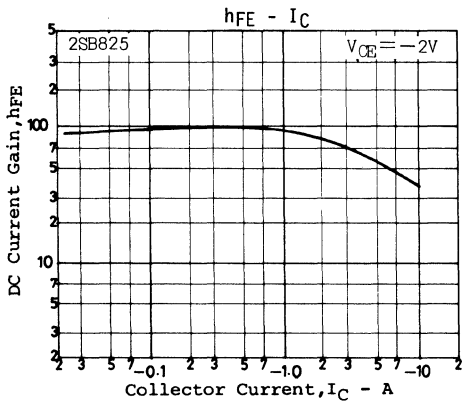
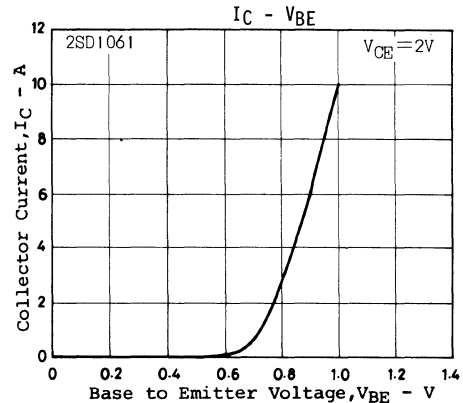
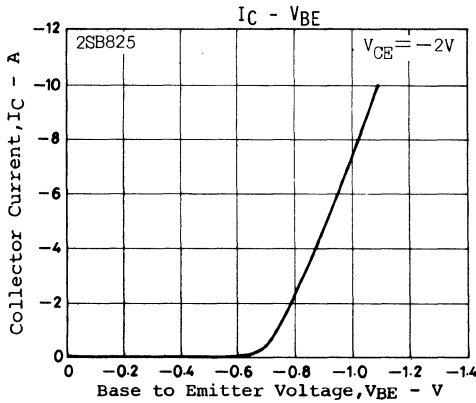
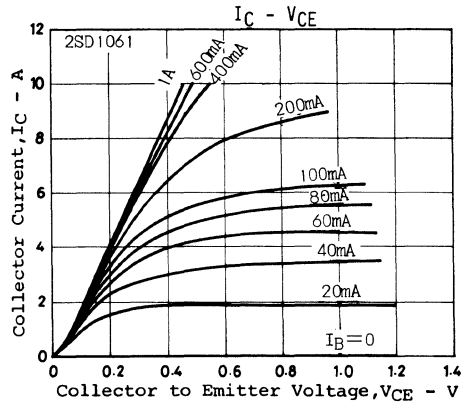
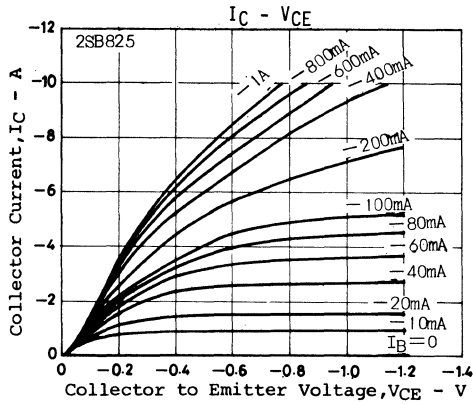


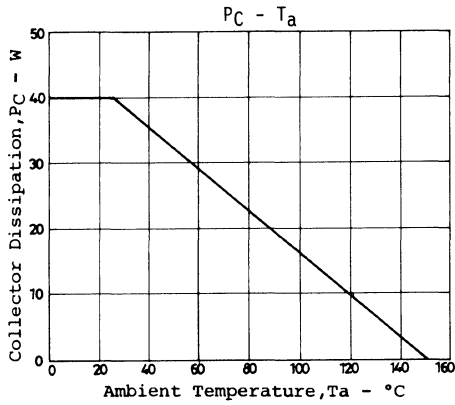
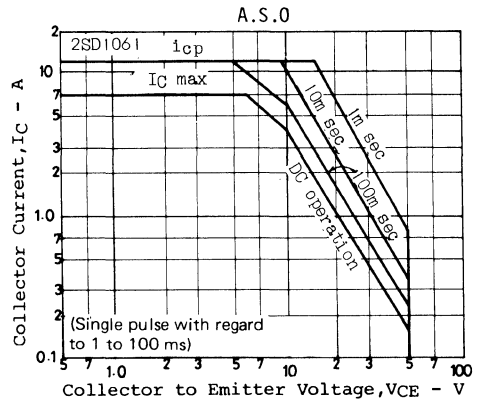
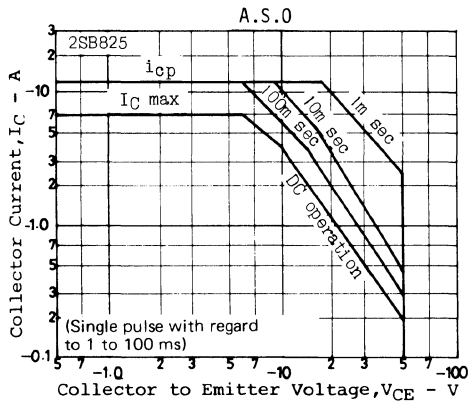
(For PNP, polarity is reversed)

Case Outline 2010A (unit:mm)

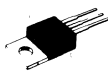


JEDEC : TO-220AB
EIAJ : SC-46





2SD1062



2010A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB826

High Current Switching Applications

©723E

APPLICATIONS

- Suitable for relay drivers, high-speed inverters, converters, and other general large-current switching

FEATURES

- Low collector-emitter saturation voltage: $V_{CE(sat)} = -0.5V$ (PNP), $0.4V$ (NPN) max.
- Wide ASO and resistant to breakdowns

Values for 2SB826 shown in ()

ABSOLUTE MAXIMUM RATINGS/ $T_a = 25^\circ C$

			unit
Collector to base voltage	V_{CBO}	(-)60	V
Collector to emitter voltage	V_{CEO}	(-)50	V
Emitter to base voltage	V_{EBO}	(-)6	V
Collector current	I_C	(-)12	A
Peak collector current	i_{cp}	(-)15	A
Allowable collector dissipation	P_C	$T_c = 25^\circ C$	40 W
Junction temperature	T_j		150 $^\circ C$
Storage ambient temperature	T_{stg}		-55~+150 $^\circ C$

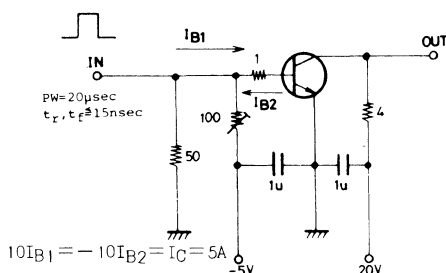
ELECTRICAL CHARACTERISTICS/ $T_a = 25^\circ C$

			min	typ	max	unit
Collector cut-off current	I_{CBO}	$V_{CB} = (-)40V, I_E = 0$			(-)0.1	mA
Emitter cut-off current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$			(-)0.1	mA
DC current gain	$h_{FE}(1)^*$	$V_{CE} = (-)2V, I_C = (-)1A$	70*		280*	
	$h_{FE}(2)$	$V_{CE} = (-)2V, I_C = (-)5A$	30			
Gain bandwidth product	f_T	$V_{CE} = (-)5V, I_C = (-)1A$		10		MHz
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C = (-)6A, I_B = (-)0.3A$			0.4 (-0.5)	V
Collector-base breakdown voltage	$V_{(BR)CBO}$	$I_C = (-)1mA, I_E = 0$	(-)60			V
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-)50			V
Emitter-base breakdown voltage	$V_{(BR)EBO}$	$I_E = (-)1mA, I_C = 0$	(-)6			V
Turn-on time	t_{on}	at the appointed circuit		(0.2)0.1		μs
Fall time	t_f	at the appointed circuit		(0.1)0.05		μs
Storage time	t_{stg}	at the appointed circuit		(0.4)1.2		μs

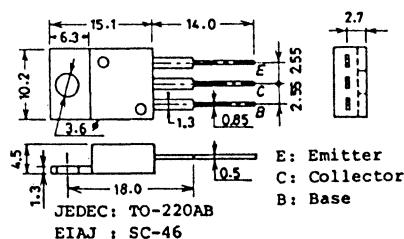
* 2SB826 and 2SD1062 are graded as follows by h_{FE} at 1A:

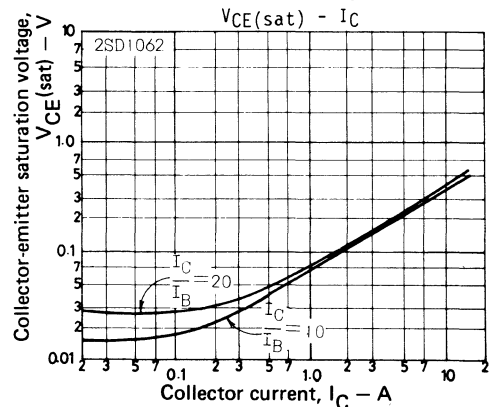
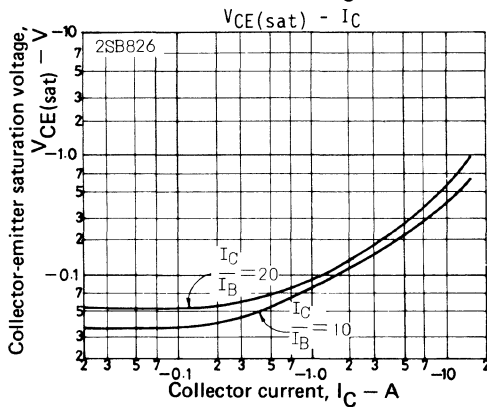
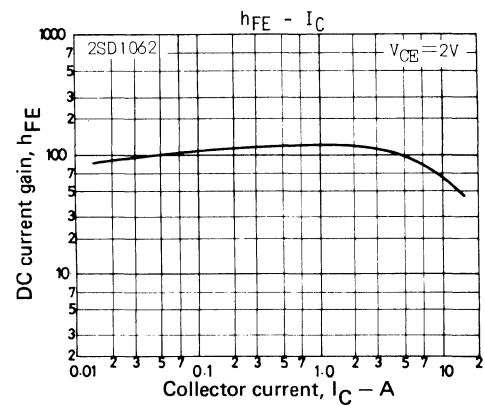
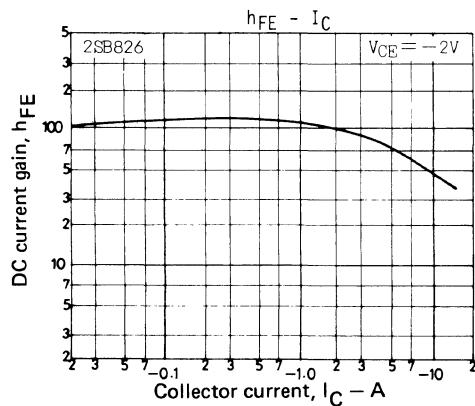
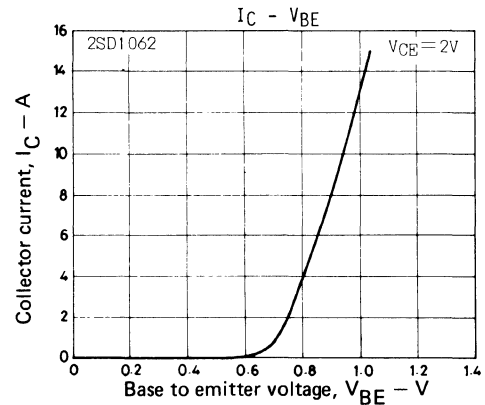
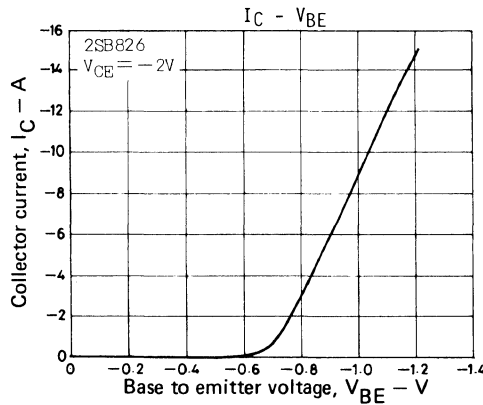
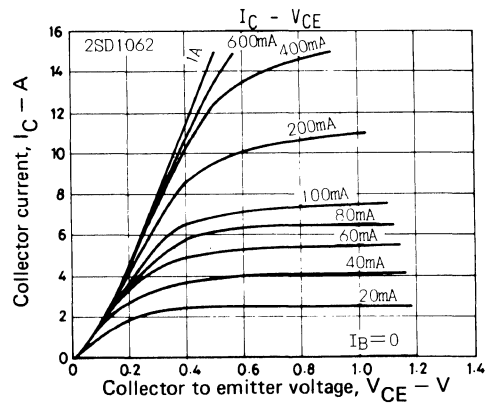
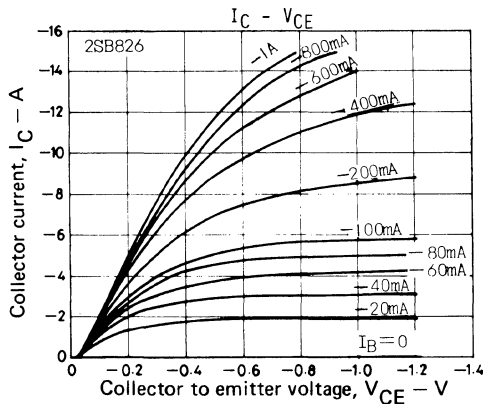
70	Q	140	100	R	200	140	S	280
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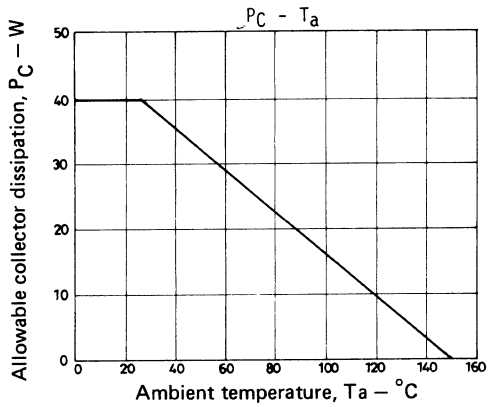
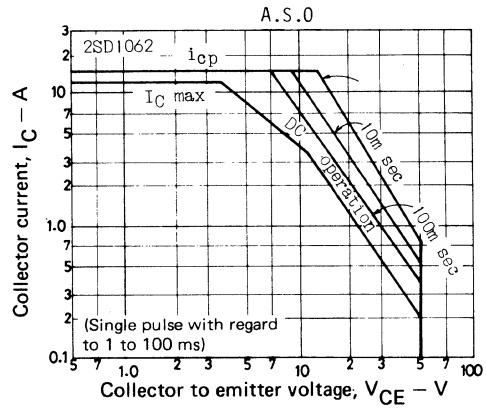
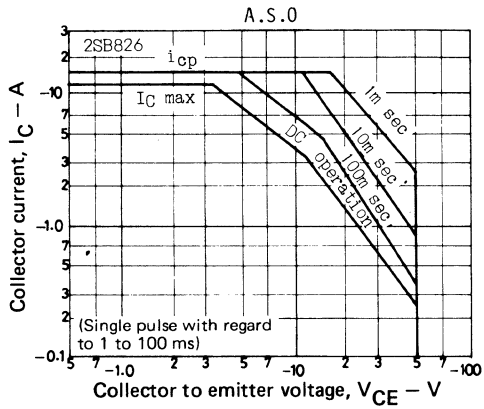
Switching time measurement circuit



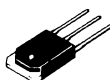
Case outline 2010A
(unit: mm)







2SD1063



2022

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB827

High Current Switching Applications

©688F

Use : Universal high current switching as solenoid driving, high speed inverter and converter.

Features :

- . Low saturation voltage : $V_{CE(sat)} = (-)0.4V$ max.
- . Wide ASO.

() shows the case of 2SB827 only.

Absolute Maximum Ratings at $T_a = 25^\circ C$

Collector to Base Voltage	V_{CBO}	(-) 60	V
Collector to Emitter Voltage	V_{CEO}	(-) 50	V
Emitter to Base Voltage	V_{EBO}	(-) 6	V
Collector Current	I_C	(-) 7	A
Peak Collector Current	i_{cp}	(-) 14	A
Collector Dissipation	P_C	$T_C = 25^\circ C$	60 W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

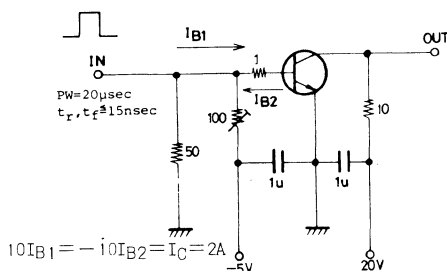
Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cut off Current	I_{CBO}	$V_{CB} = (-) 40V, I_E = 0$		(-) 0.1		mA
Emitter Cut off Current	I_{EBO}	$V_{EB} = (-) 4V, I_C = 0$		(-) 0.1		mA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE} = (-) 2V, I_C = (-) 1A$	70*		280*	
	$h_{FE}(2)$	$V_{CE} = (-) 2V, I_C = (-) 5A$	30			
Gain Bandwidth Product	f_T	$V_{CE} = (-) 5V, I_C = (-) 1A$		10		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-) 4A, I_B = (-) 0.4A$		(-) 0.4		V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-) 1mA, I_E = 0$	(-) 60			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-) 1mA, R_{BE} = \infty$	(-) 50			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-) 1mA, I_C = 0$	(-) 6			V
Turn-on Time	t_{on}	At the test circuit		0.2		usec
Fall Time	t_f	At the test circuit	(0.1) 0.3			usec
Storage Time	t_{stg}	At the test circuit	(0.7) 0.9			usec

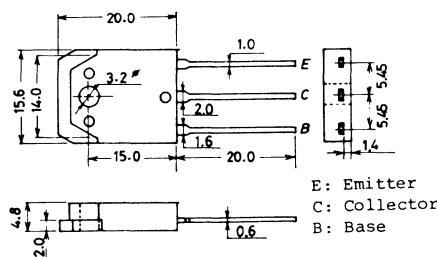
*2SB827, 2SD1063 are classified by 2V 1A h_{FE} as follows :

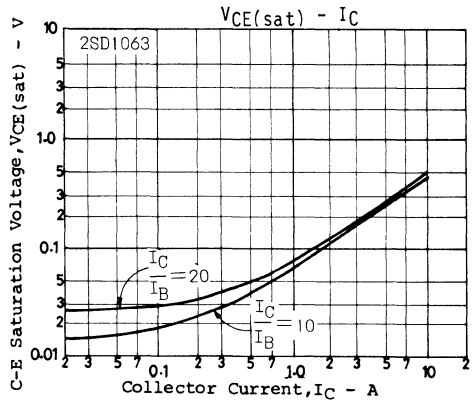
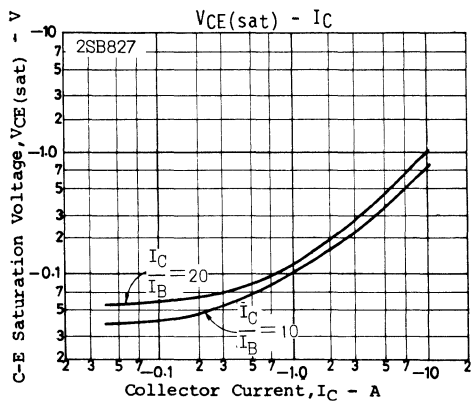
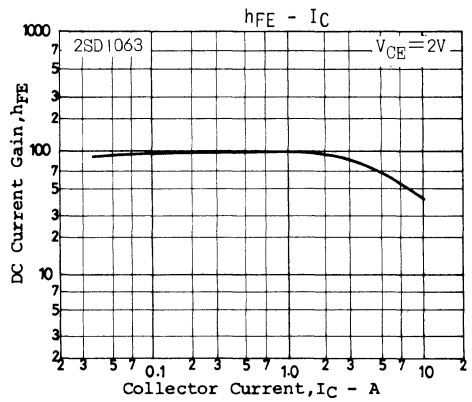
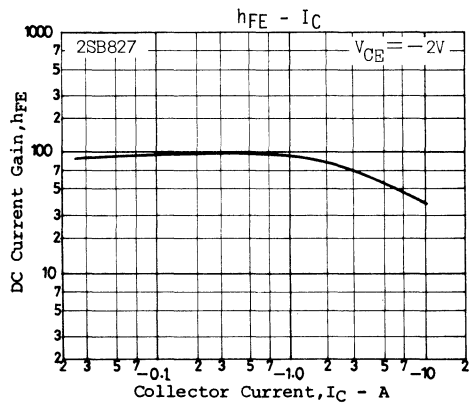
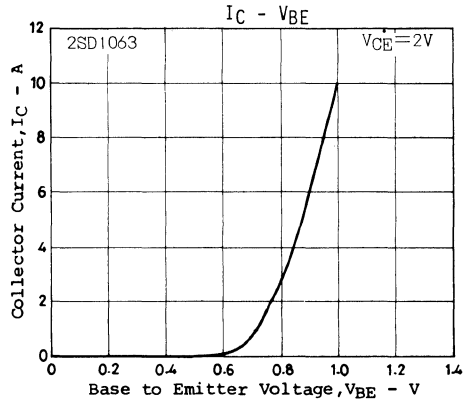
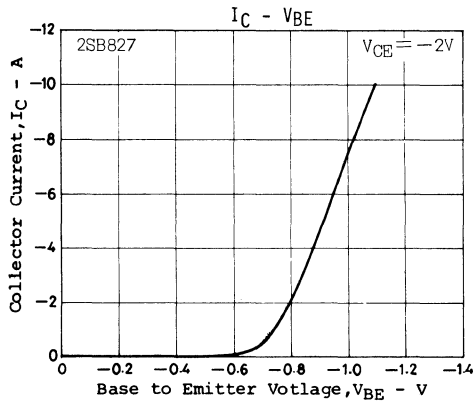
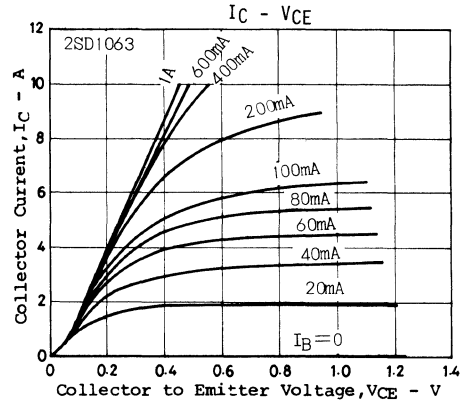
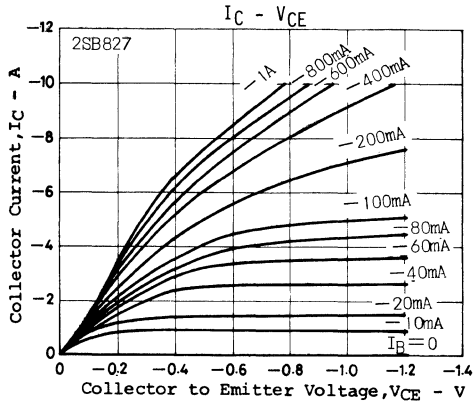
70	Q	140	100	R	200	140	S	280
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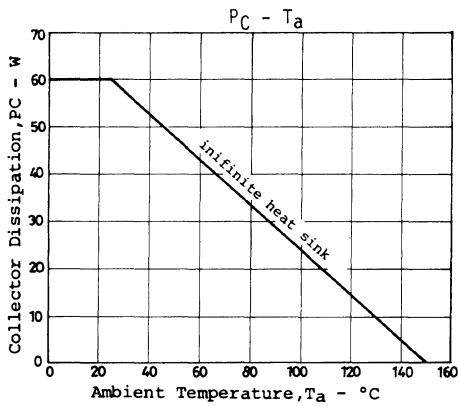
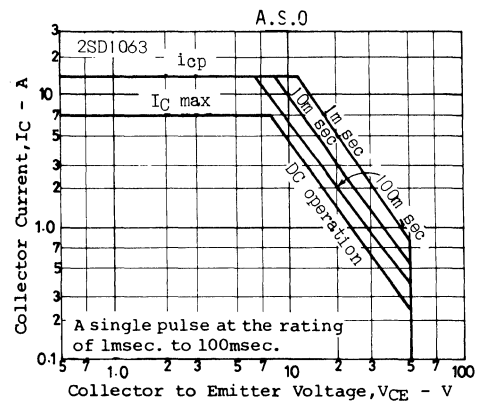
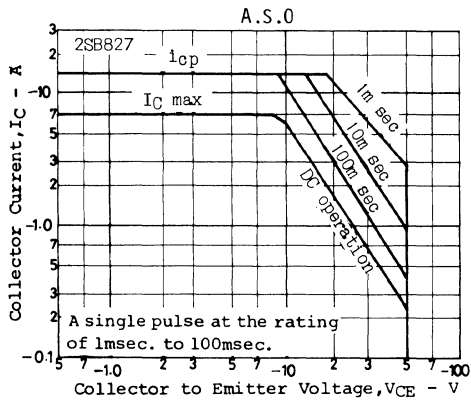
Switching Time Test Circuit



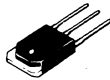
Case Outline 2022 (unit:mm)







2SD1064



2022

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB828

High Current Switching Applications

©722E

Use : Universal high current switching as solenoid driving, high speed inverter and converter.

Features :

- . Low saturation voltage : $V_{CE(sat)} = -0.5V(\text{PNP})$, $0.4V(\text{NPN})$ max.
- . Wide ASO.

() shows the case of 2SB828 only.

Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$

Collector to Base Voltage	V_{CBO}	(-)60	V
Collector to Emitter Voltage	V_{CEO}	(-)50	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)12	A
Peak Collector Current	i_{cp}	(-)17	A
Collector Dissipation	P_C	80	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

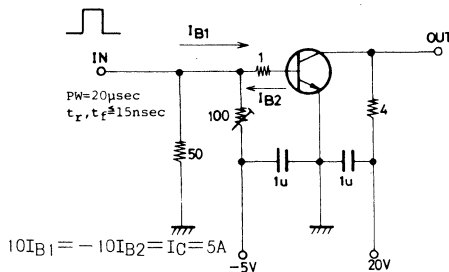
Electrical Characteristics at $T_a = 25^\circ\text{C}$

		min	typ	max	unit
Collector Cut off Current	I_{CBO}			(-)0.1	mA
Emitter Cut off Current	I_{EBO}			(-)0.1	mA
DC Current Gain	$h_{FE}(1)^*$		70*	280*	
	$h_{FE}(2)$		30		
Gain Bandwidth Product	f_T		10		MHz
C-E Saturation Voltage	$V_{CE(sat)}$			(-0.5)	V
C-B Breakdown Voltage	$V_{(BR)CBO}$			(-)60	V
C-E Breakdown Voltage	$V_{(BR)CEO}$			(-)50	V
E-B Breakdown Voltage	$V_{(BR)EBO}$			(-)6	V
Turn-on Time	t_{on}		(0.2)0.1		usec
Fall Time	t_f		(0.1)0.05		usec
Storage Time	t_{stg}		(0.4)1.2		usec

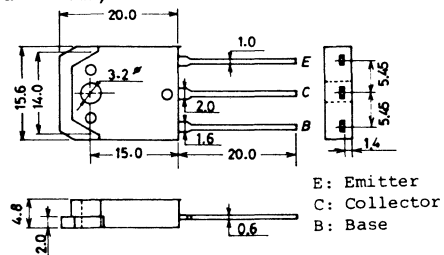
*2SB828, 2SD1064 are classified by 1A h_{FE} as follows :

70	Q	140	100	R	200	140	S	280
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Switching Time test Circuit

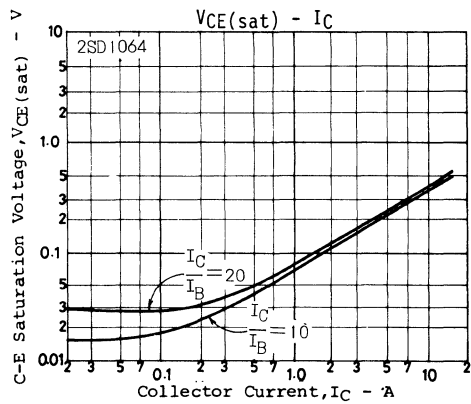
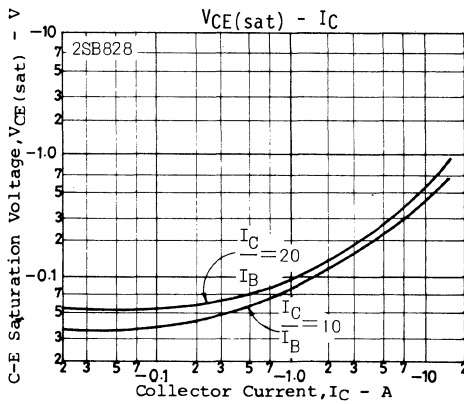
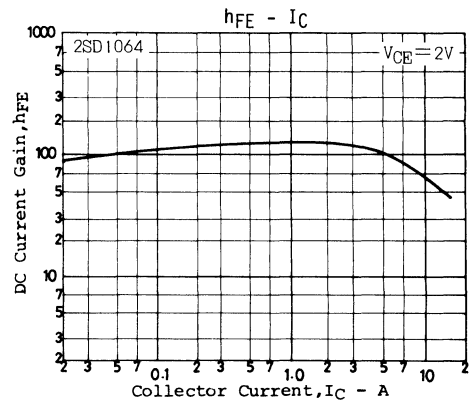
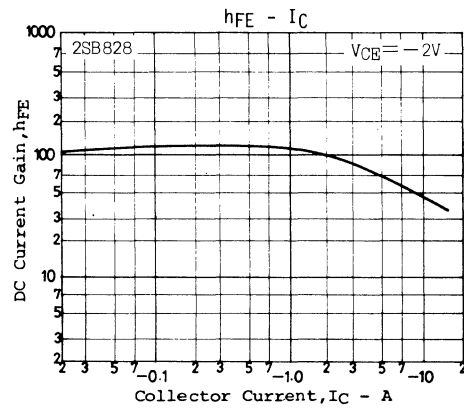
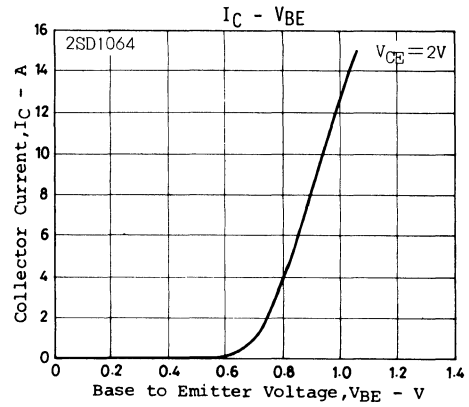
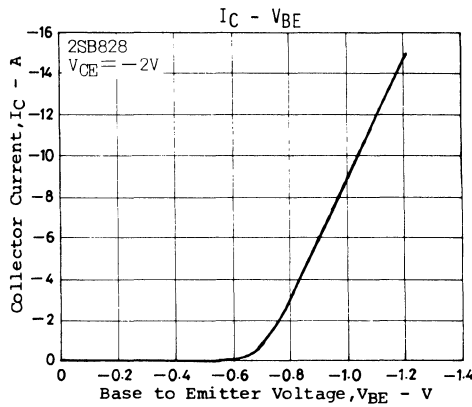
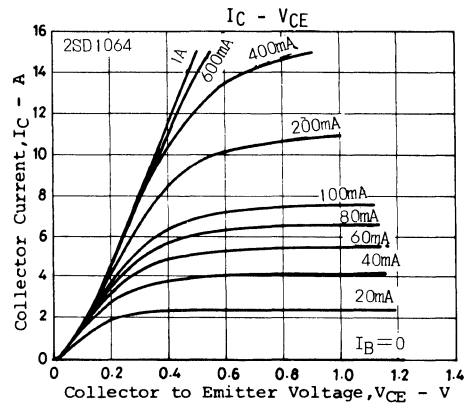
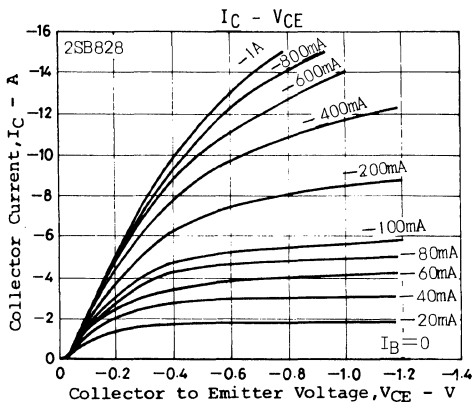


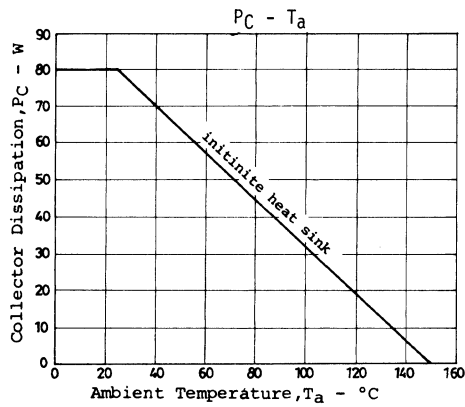
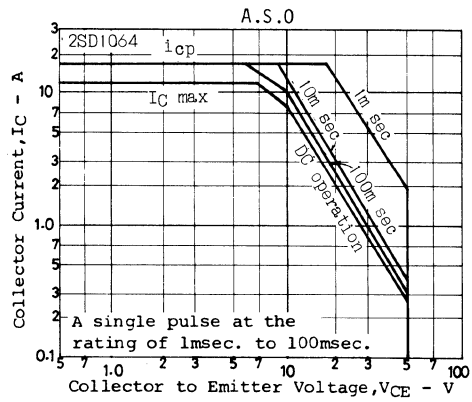
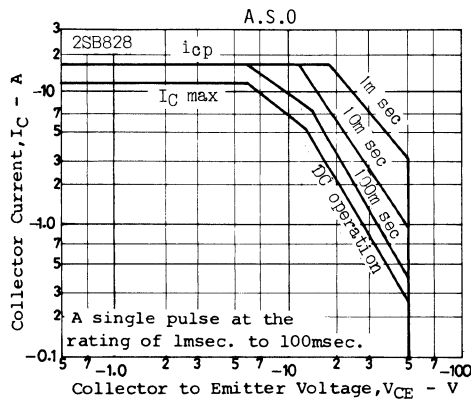
Case Outline 2022 (unit:mm)



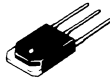
E: Emitter
C: Collector
B: Base

7011KI No.722-1/3





2SD1065



2022

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB829

High Current Switching Applications

Ⓔ825A

APPLICATIONS

- Suitable for relay drivers, high-speed inverters, converters, and other general large-current switching

FEATURES

- Low collector-emitter saturation voltage: $V_{CE(sat)} = (-)0.5V$ max.
- Wide ASO and resistant to breakdowns

Values for 2SB829 shown in ()

ABSOLUTE MAXIMUM RATINGS/ $T_a = 25^\circ C$

			unit
Collector to base voltage	V_{CBO}	(-)60	V
Collector to emitter voltage	V_{CEO}	(-)50	V
Emitter to base voltage	V_{EBO}	(-)6	V
Collector current	I_C	(-)15	A
Peak collector current	i_{cp}	(-)20	A
Allowable collector dissipation	P_C	$T_c = 25^\circ C$ 90	W
Junction temperature	T_j	150	$^\circ C$
Storage ambient temperature	T_{stg}	-55~+150	$^\circ C$

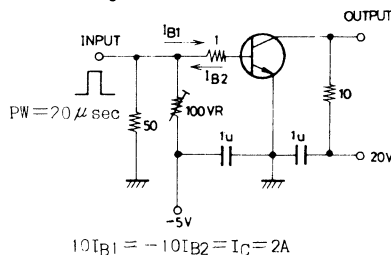
ELECTRICAL CHARACTERISTICS/ $T_a = 25^\circ C$

			min	typ	max	unit
Collector cut-off current	I_{CBO}	$V_{CB} = (-)40V, I_E = 0$			0.1	mA
Emitter cut-off current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$			0.1	mA
DC current gain	$h_{FE}(1)^*$	$V_{CE} = (-)2V, I_C = (-)1A$	70*		280*	
	$h_{FE}(2)$	$V_{CE} = (-)2V, I_C = (-)8A$	30			
Gain bandwidth product	f_T	$V_{CE} = (-)5V, I_C = (-)1A$		20		MHz
Collector-emitter breakdown voltage	$V_{CE(sat)}$	$I_C = (-)8A, I_B = (-)0.4A$		(-0.26)	(-0.5)	V
				0.18	0.4	V
Collector-base breakdown voltage	$V_{(BR)CBO}$	$I_C = (-)1mA, I_E = 0$		(-)60		V
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$		(-)50		V
Emitter-base breakdown voltage	$V_{(BR)EBO}$	$I_E = (-)1mA, I_C = 0$		(-)6		V
Turn-on time	t_{on}	at the appointed circuit		0.2		μs
Storage time	t_{stg}	at the appointed circuit		(0.5)1.0		μs
Fall time	t_f	at the appointed circuit		0.1		μs

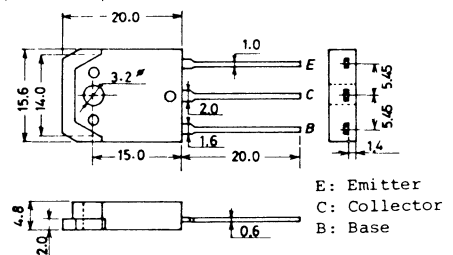
* 2SB829 and 2SD1065 are graded as follows by h_{FE} at 1A:

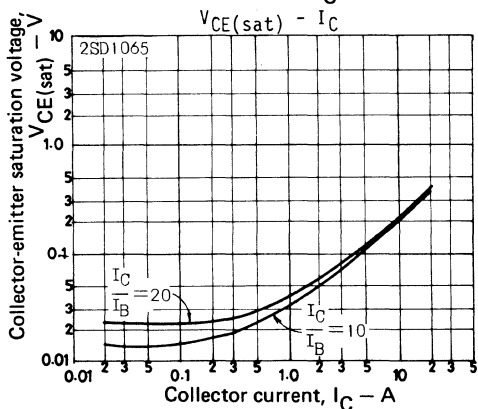
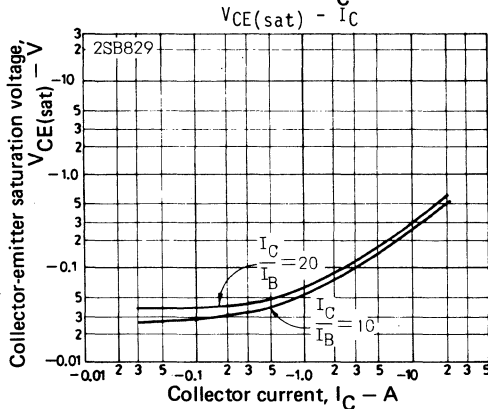
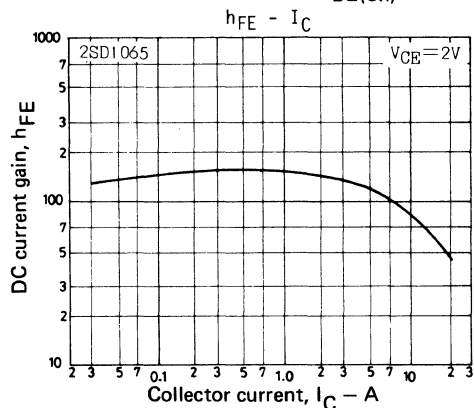
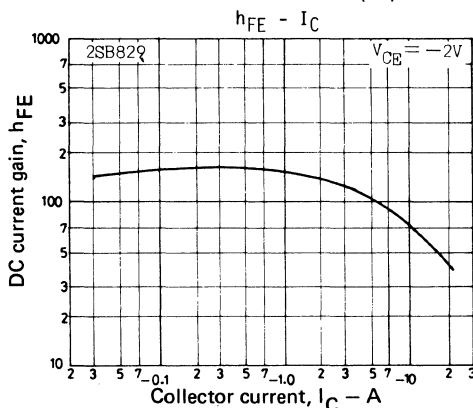
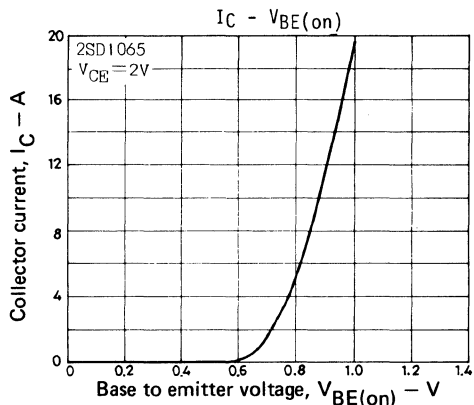
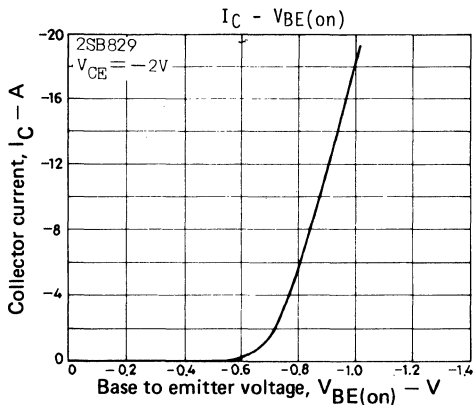
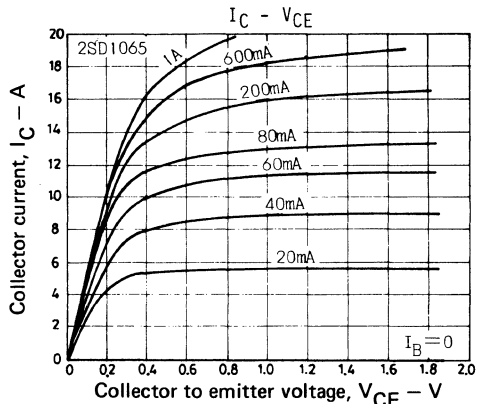
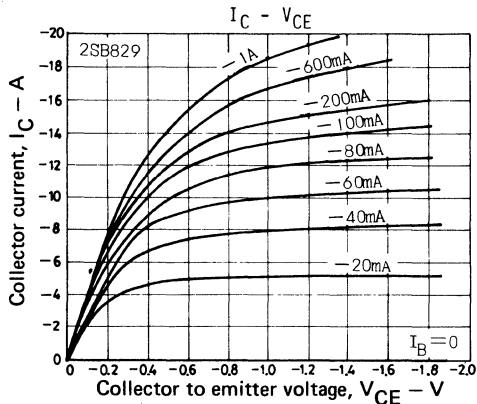
70	Q	140	100	R	200	140	S	280
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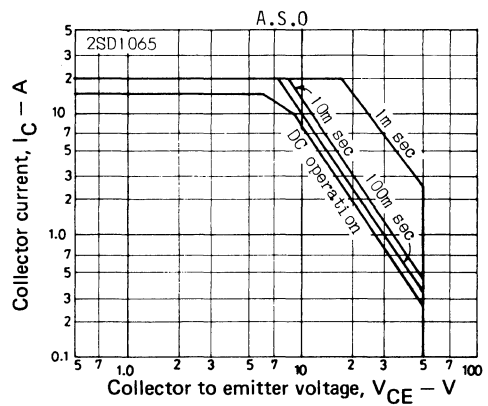
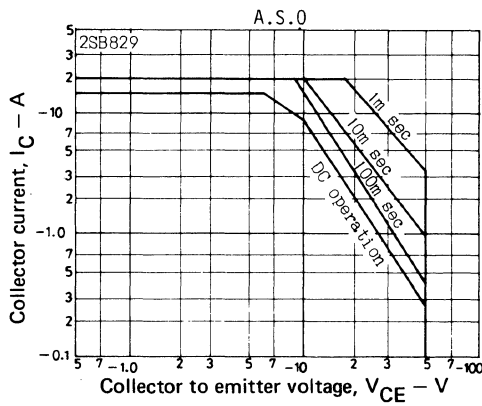
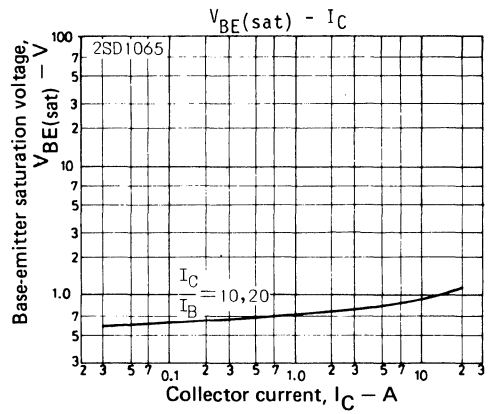
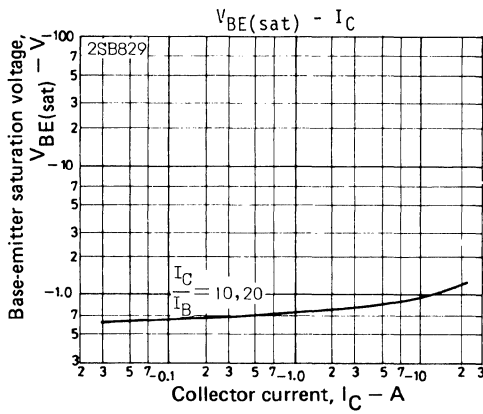
Switching time measurement circuit



Case outline 2022
(unit: mm)







2SD1111



2003A

NPN Epitaxial Planar
Silicon Darlington Transistor

Driver Applications

©751B

Applications

- Motor drivers, printer hammer drivers, relay drivers, voltage regulators.

Features

- High DC current gain (5000 or greater).
- Large current capacity and wide ASO.
- Low saturation voltage ($V_{CE(sat)}=0.8V$ typ).

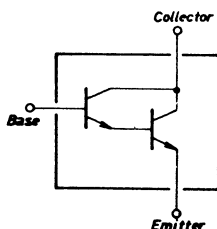
Absolute Maximum Ratings at $T_a=25^{\circ}C$

			unit
Collector to Base Voltage	V_{CBO}	80	V
Collector to Emitter Voltage	V_{CEO}	50	V
Emitter to Base Voltage	V_{EBO}	10	V
Collector Current	I_C	0.7	A
Peak Collector Current	i_{cp}	2	A
Collector Dissipation	P_C	600	mW
Junction Temperature	T_j	150	$^{\circ}C$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}C$

Electrical Characteristics at $T_a=25^{\circ}C$

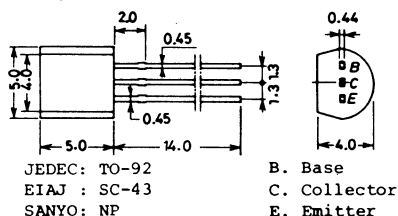
		min	typ	max	unit
Collector Cutoff Current	I_{CBO} $V_{CB}=40V, I_E=0$			0.1	μA
Emitter Cutoff Current	I_{EBO} $V_{EB}=8V, I_C=0$			0.1	μA
DC Current Gain	$h_{FE(1)}$ $V_{CE}=2V, I_C=50mA$	5000			
	$h_{FE(2)}$ $V_{CE}=2V, I_C=500mA$	4000			
Gain Bandwidth Product	f_T $V_{CE}=5V, I_C=50mA$		200		MHz
Output Capacitance	c_{ob} $V_{CB}=10V, f=1MHz$		10		pF
C-E Saturation Voltage	$V_{CE(sat)}$ $I_C=100mA, I_B=0.1mA$	0.8	1.2		V
B-E Saturation Voltage	$V_{BE(sat)}$ $I_C=100mA, I_B=0.1mA$	1.3	2.0		V
C-B Breakdown Voltage	$V_{(BR)CBO}$ $I_C=10\mu A, I_E=0$	80			V
C-E Breakdown Voltage	$V_{(BR)CEO}$ $I_C=1mA, R_{BE}=\infty$	50			V
E-B Breakdown Voltage	$V_{(BR)EBO}$ $I_E=10\mu A, I_C=0$	10			V

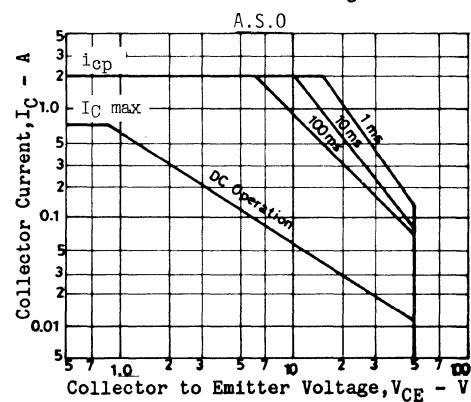
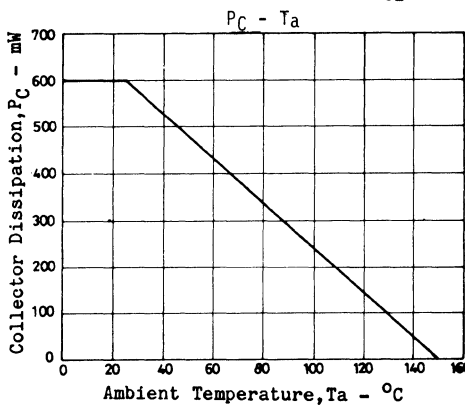
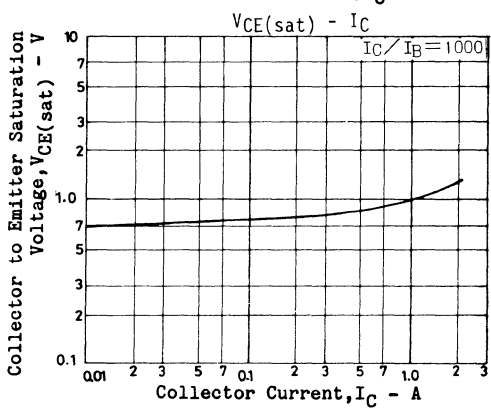
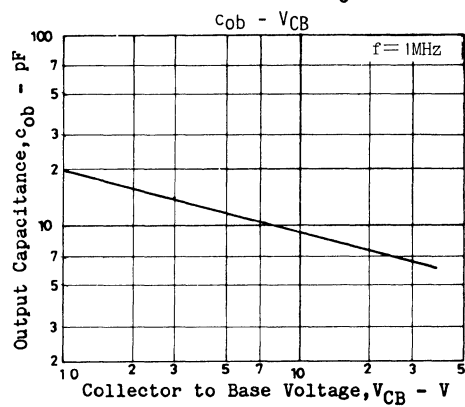
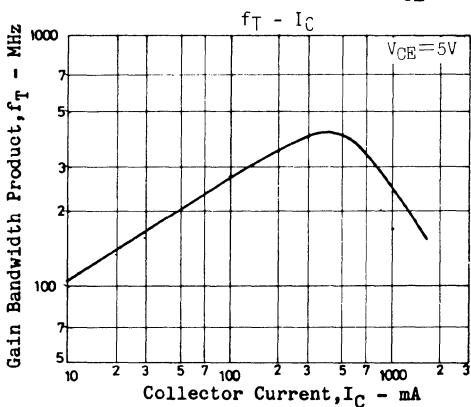
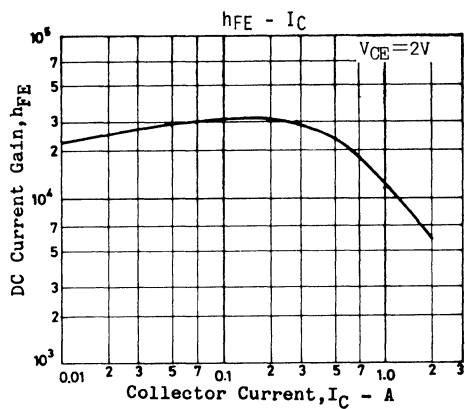
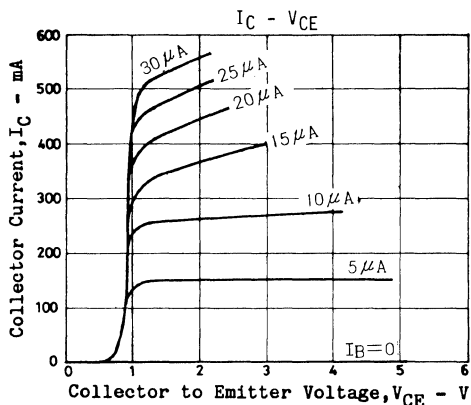
Electrical Connection



Case Outline 2003A

(unit:mm)





2SD1145



2006A

NPN Epitaxial Planar
Silicon Transistor

High Current Driver Applications

©784D

Use : Solenoid driving, hammer driving, lamp driving, motor driving and dc-dc converter of electronic flash.

Features :

- . Low saturation voltage.
- . Large current capability and wide ASO.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

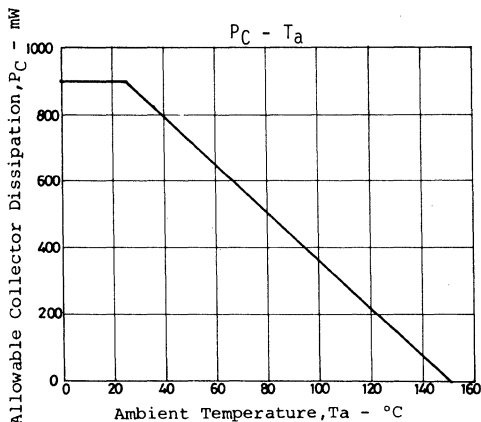
			unit
Collector to Base Voltage	V_{CBO}	60	V
Collector to Emitter Voltage	V_{CEO}	20	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	5	A
Peak Collector Current	i_{cp}	100ms, 1.pulse	8 A
Collector Dissipation	P_C	0.9	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

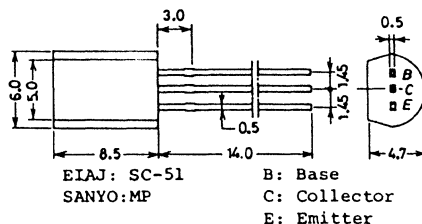
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=50V, I_E=0$			1.0	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			1.0	μA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=2V, I_C=0.5A$	100*		560*	
	$h_{FE}(2)$	$V_{CE}=2V, I_C=3A$ (Pulse)	75			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=50\text{mA}$		120		MHz
Output Capacitance	C_{ob}	$V_{CB}=10V, f=1\text{MHz}$		45		pF
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=3A, I_B=60\text{mA}$ (Pulse)			0.5	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=3A, I_B=60\text{mA}$ (Pulse)			1.5	V

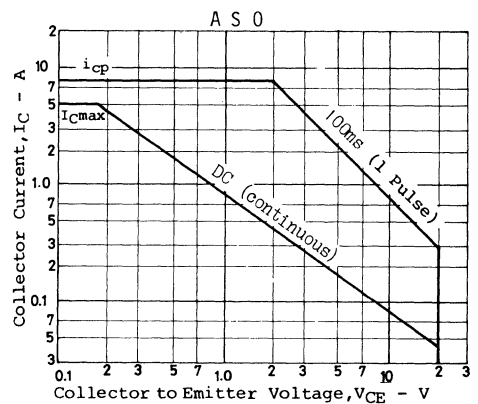
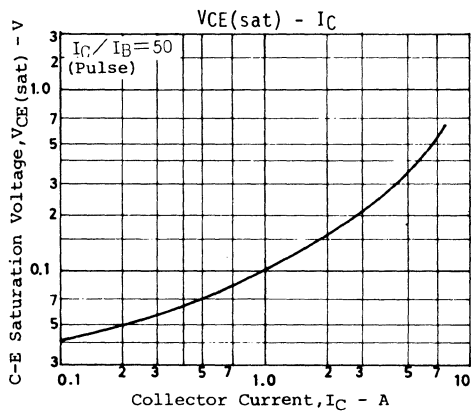
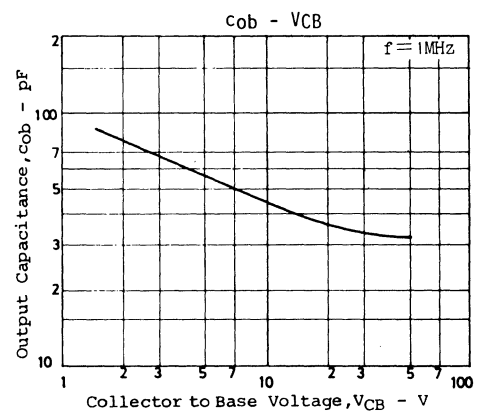
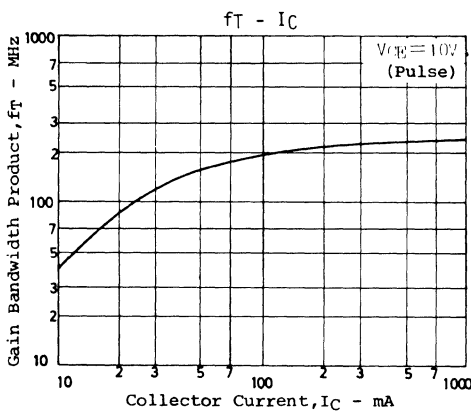
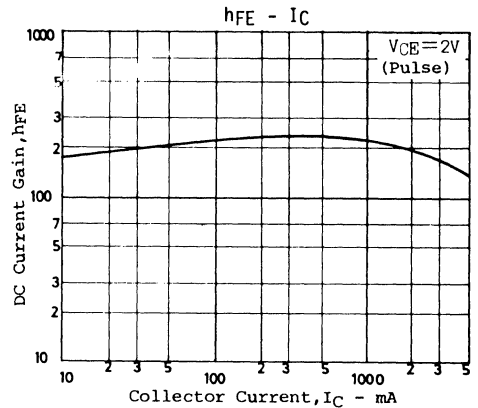
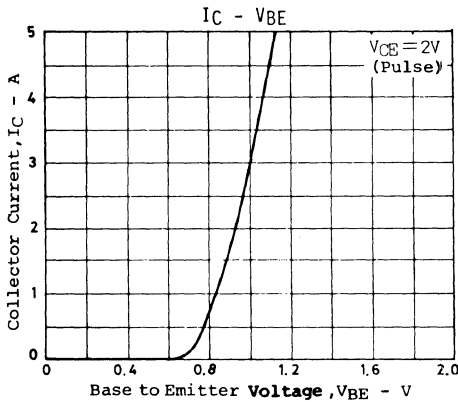
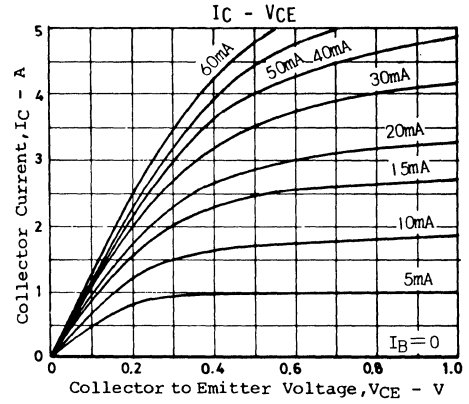
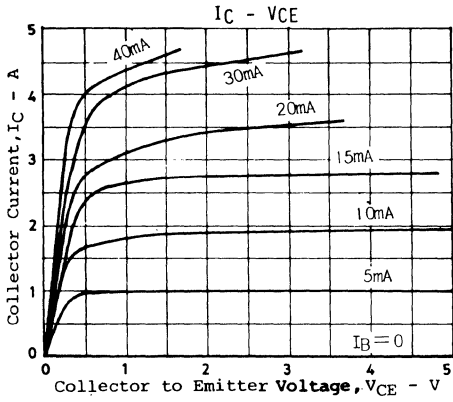
*2SD1145 is graded as follows by h_{FE} at 1A :

100	E	200	160	F	320	280	G	560
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Case Outline 2006A (unit:mm)





2SD1153



2006A

NPN/PNP Epitaxial Planar
Silicon Darlington Transistors**2SB865**

Driver Applications

©828C

() : 2SB865

Uses

- Relay drivers, hammer drivers, lamp drivers, motor drivers

Features

- High DC current gain (4000 or more)
- Large current capacity and wide ASO
- Low saturation voltage

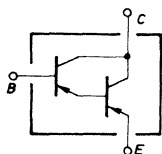
Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)80	V
Collector to Emitter Voltage	V_{CEO}	(-)50	V
Emitter to Base Voltage	V_{EBO}	(-)10	V
Collector Current	I_C	(-)1.5	A
Peak Collector Current	i_{cp}	(-)3	A
Collector Dissipation	P_C	900	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

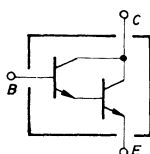
Electrical Characteristics/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)8\text{V}, I_C=0$			(-)0.1	μA
Common Emitter Current Gain	$h_{FE}(1)$	$V_{CE}=(-)2\text{V}, I_C=(-)500\text{mA}$	4000			
	$h_{FE}(2)$	$V_{CE}=(-)2\text{V}, I_C=(-)10\text{mA}$	3000			
Gain Band-width Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		120		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500\text{mA}, I_B=(-)0.5\text{mA}$		(-)0.9	(-)1.5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500\text{mA}, I_B=(-)0.5\text{mA}$		(-)1.5	(-)2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)80			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	(-)50			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$	(-)10			V

Electrical Connection

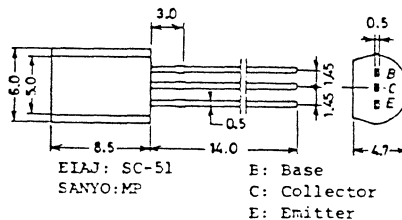


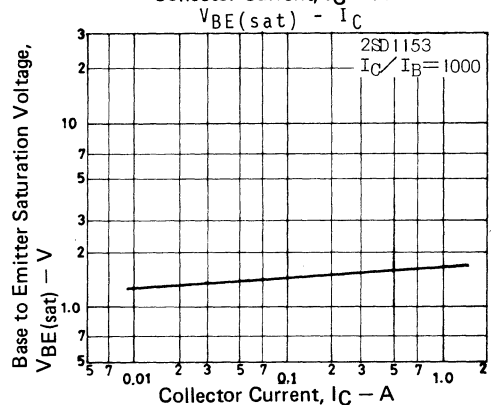
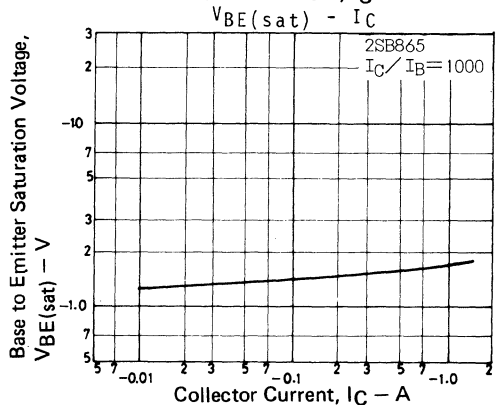
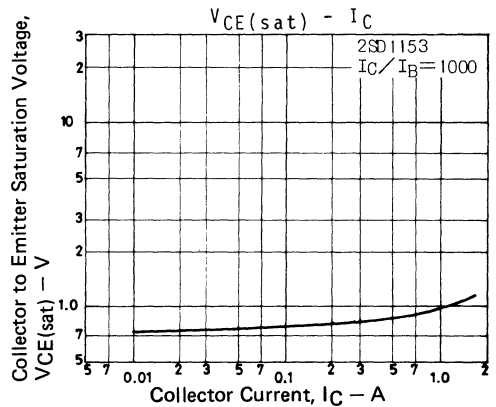
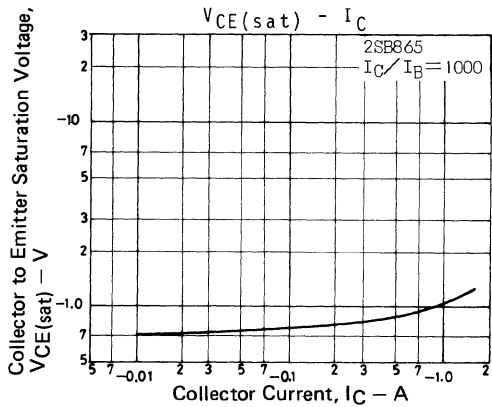
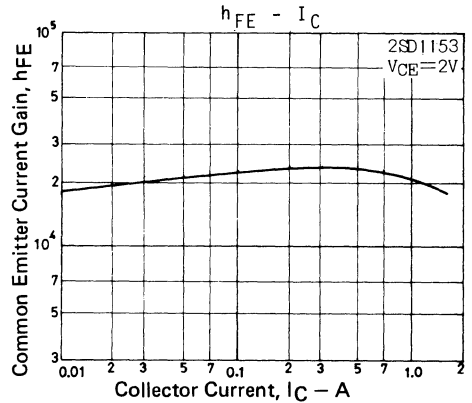
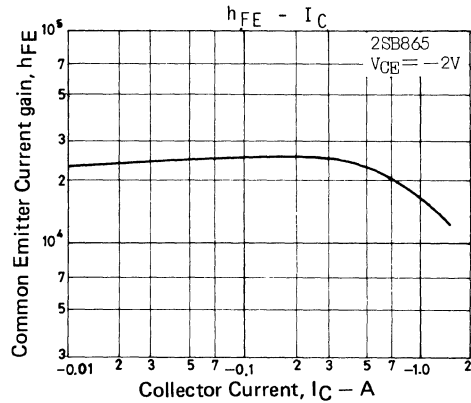
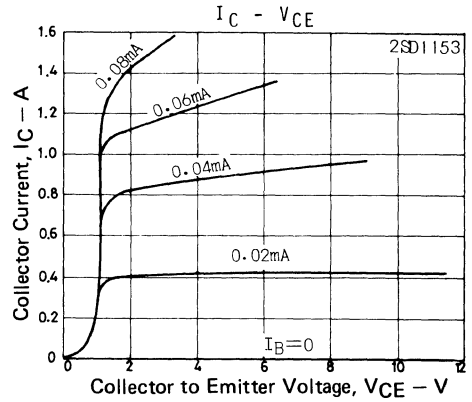
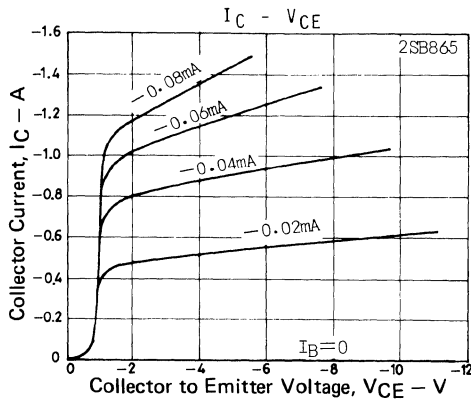
(2SB865)

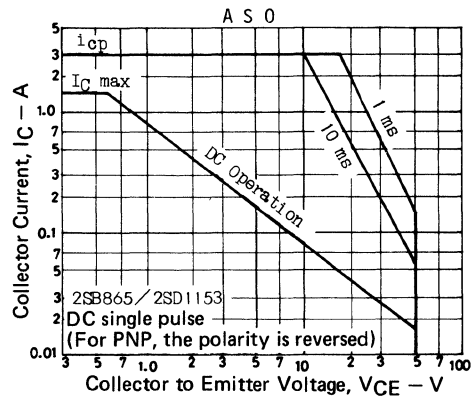
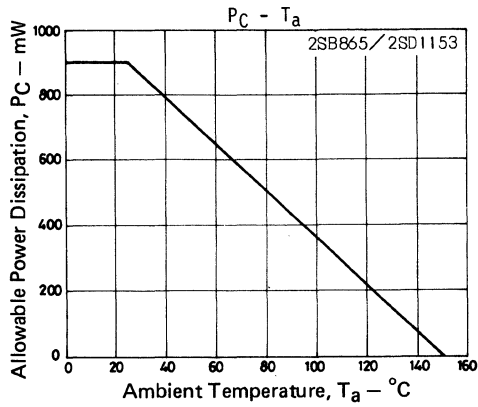


(2SD1153)

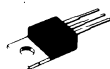
Case Outline 2006A (unit:mm)







2SD1159



2010A

NPN Triple Diffused Planar
Silicon Transistor

Horizontal Deflection Output, High Current Switching Applications

©837B

Features

- Capable of efficient drive with small internal loss due to excellent t_f .

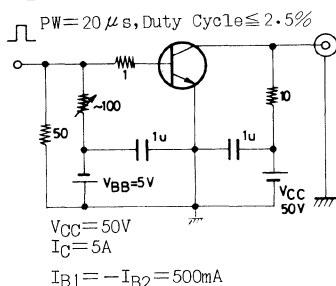
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	200	V
Collector to Emitter Voltage	V_{CE0}	60	V
Emitter to Base Voltage	V_{EB0}	6	V
Collector Current	I_C	4.5	A
Peak Collector Current	i_{cp}	10	A
Collector Dissipation	P_C	40	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

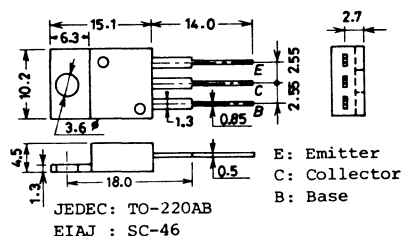
Electrical Characteristics at $T_a=25^\circ\text{C}$

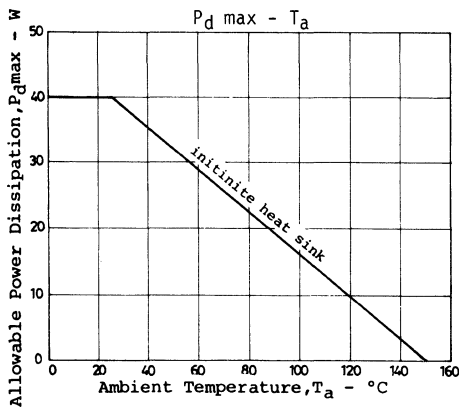
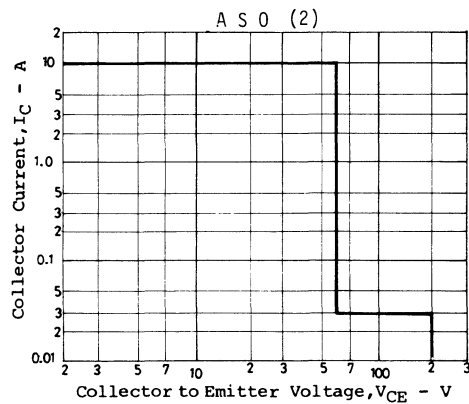
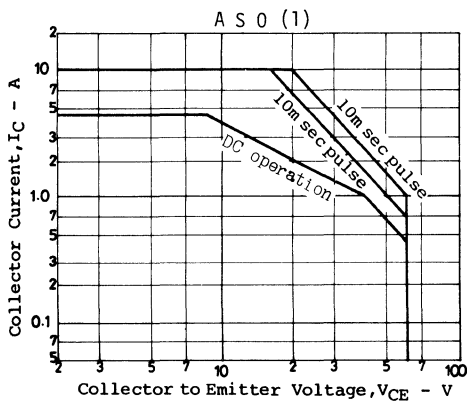
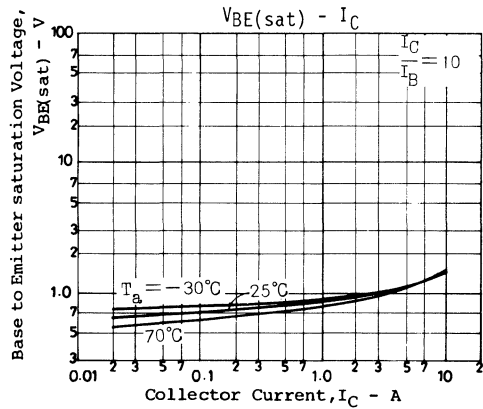
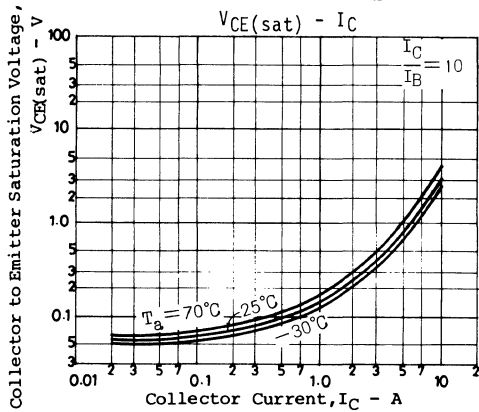
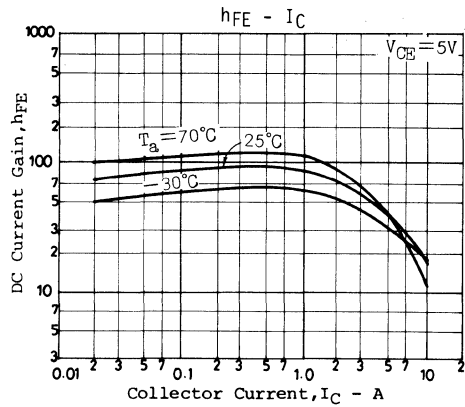
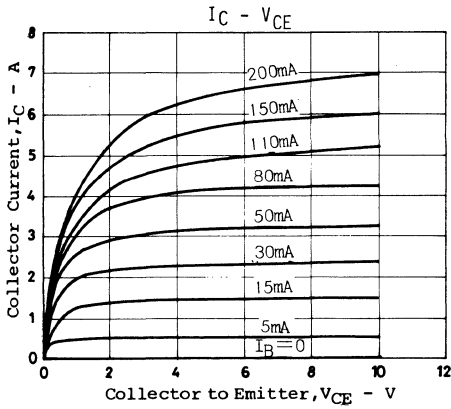
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=40\text{V}, I_E=0$			0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5\text{V}, I_C=0$			0.1	mA
DC Current Amplification Factor	$h_{FE}(1)$	$V_{CE}=5\text{V}, I_C=1\text{A}$	30		160	
	$h_{FE}(2)$	$V_{CE}=5\text{V}, I_C=4\text{A}$	25			
Gain Band Product	f_T	$V_{CE}=5\text{V}, I_C=1\text{A}$		10		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=4\text{A}, I_B=0.4\text{A}$	0.5	1.0		V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=4\text{A}, I_B=0.4\text{A}$		1.5		V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5\text{mA}, I_B=0$	200			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=5\text{mA}, R_{BE}=\infty$	60			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=5\text{mA}, I_C=0$	6			V
Fall Time	t_f	Based on the following specified test circuit.	0.2	0.5		us

Specified Test Circuit



Case Outline 2010A (unit:mm)





2SD1161

2018

NPN Epitaxial Planar
Silicon Transistor

Piezoelectric Buzzer Driver Applications (with Emitter Resistance)

©849A

Features

- . Very small-sized package permitting 2SD1161-used sets to be made smaller, slimmer.
- . On-chip emitter resistance.

Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CBO}	30	V
Collector to Emitter Voltage	V_{CEO}	15	V
Emitter to Base Voltage	V_{EBO}	5	V
Collector Current	I_C	30	mA
Collector Dissipation	P_C	150	mW
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

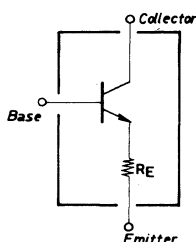
Electrical Characteristics at Ta=25°C

		min	typ	max	unit
Collector Cutoff Current	I_{CBO} $V_{CB}=15V, I_E=0$			0.1	uA
Emitter Cutoff Current	I_{EBO} $V_{EB}=3V, I_C=0$			0.1	uA
DC Current Gain	h_{FE}^* $V_{CE}=6V, I_C=1mA$	90*		400*	
Gain Bandwidth Product	f_T $V_{CE}=6V, I_C=1mA$		100		MHz
Output Capacitance	c_{ob} $V_{CB}=6V, f=1MHz$		6		pF
Emitter Resistance	R_E	100		160	ohm
C-E Saturation Voltage	$V_{CE(sat)}$ $I_C=10mA, I_B=1mA$	1.0		2.0	V

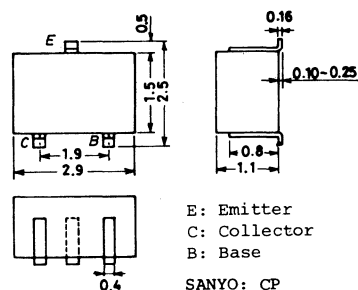
* The 2SD1161 is classified by 1mA h_{FE} as follows:

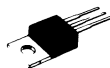
90	P4	180	135	P5	270	200	P6	400
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Electrical Connection



Case Outline 2018 (unit:mm)





2010A

NPN/PNP Epitaxial Planar Silicon Darlington Transistors

2SB880

Driver Applications

Ⓔ924B

Applications

- Motor drivers, printer hammer drivers, relay drivers, voltage regulators

Features

- High DC current gain
- Large current capacity and wide ASO
- Low saturation voltage

(): 2SB880

Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$

Absolute Maximum Ratings/T _a =25°C			unit
Collect to Base Voltage	V _{CB0}	(-)70	V
Collector to Emitter Voltage	V _{CE0}	(-)60	V
Emitter to Base Voltage	V _{EB0}	(-)6	V
Collector Current	I _C	(-)4	A
Peak Collector Current	i _{cp}	(-)6	A
Collector Dissipation	P _C	1.75	W
		T _c =25°C	30
			W
Junction Temperature	T _j	150	°C
Storage Temperature	T _{sta}	-55 to +150	°C

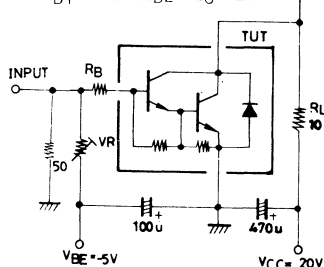
Electrical Characteristics/ $T_a=25^{\circ}\text{C}$

Electrical Characteristics/ $T_a=25^{\circ}\text{C}$			min	typ	max	unit
Collector Cut-off Current	I_{CBO}	$V_{CB}=(-)40, I_E=0$			$(-)0.1$	mA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=(-)5V, I_C=0$			$(-)3.0$	mA
DC Current Gain	h_{FE}	$V_{CE}=(-)2V, I_C=(-)2A$	2000	5000		
Gain Band-width Product	f_T	$V_{CE}=(-)5V, I_C=(-)2A$		20		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)2A, I_B=(-)4mA$		0.9	$(-)1.5$	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)2A, I_B=(-)4mA$			$(-)2.0$	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5mA, I_E=0$	$(-)70$			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50mA, R_{BE}=\infty$	$(-)60$			V
Turn-on Time	t_{on}	At Specified Test Circuit		(0.5)0.6		μs
Storage Time	t_{stg}	"		(1.4)2.7		μs
Fall Time	t_f	"		(1.2)1.6		μs

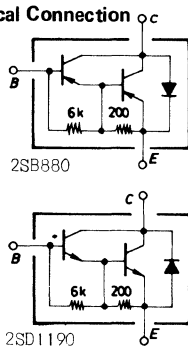
Specified Test Circuit

(For PNP, polarity is reversed.)

PW=50 μ s, Duty Cycle $\leq$ 1%

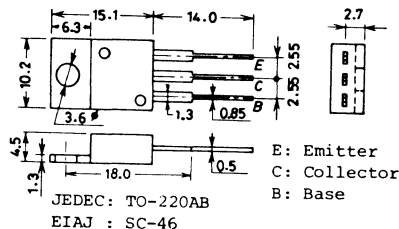
$$500I_{B1} = -500I_{B2} = I_C = 2A$$


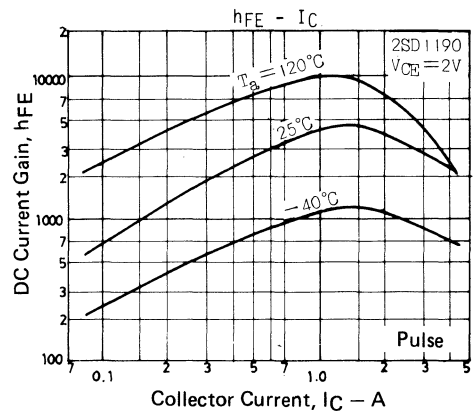
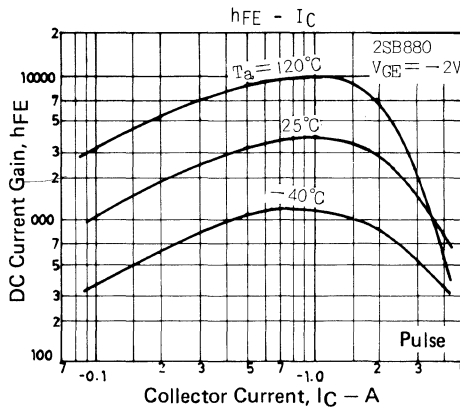
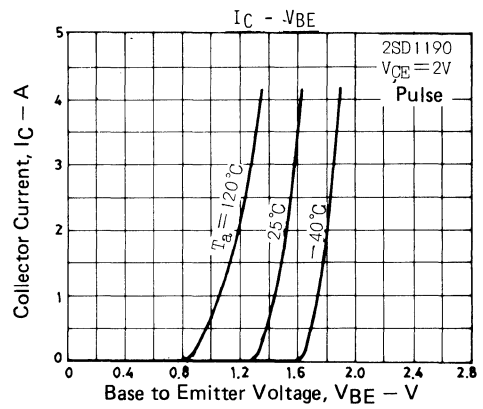
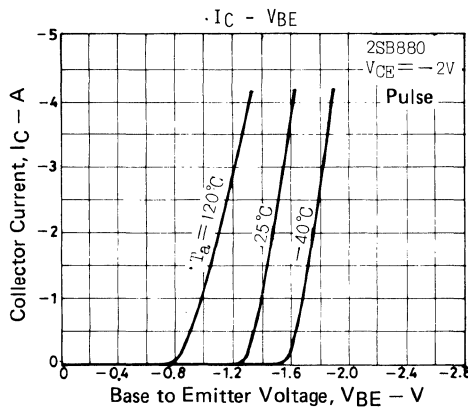
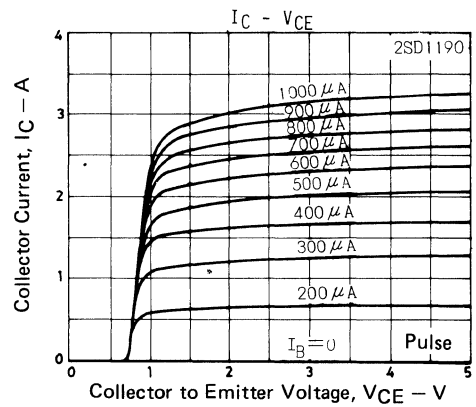
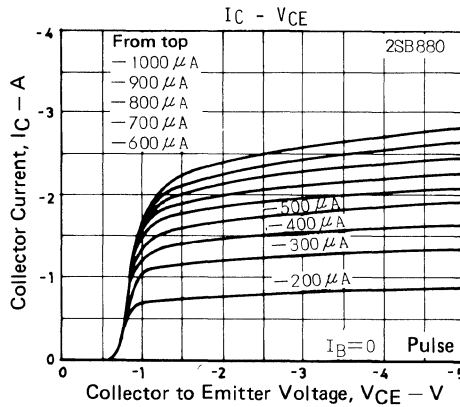
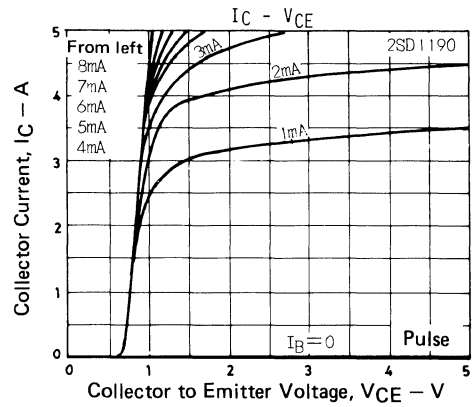
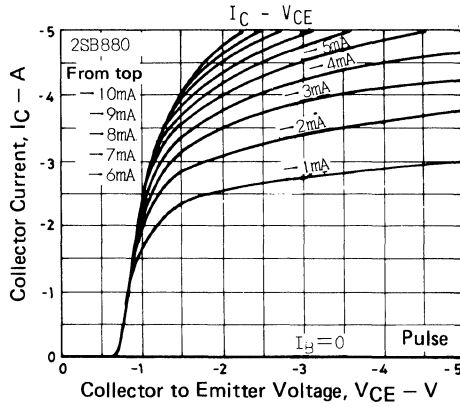
Electrical Connection

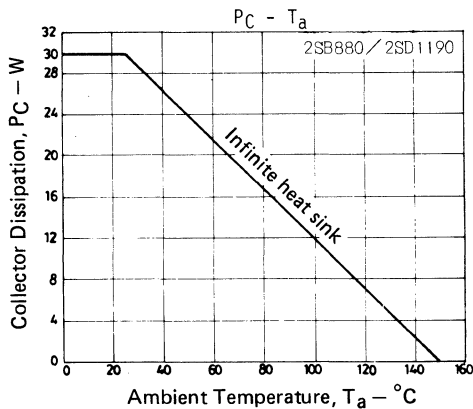
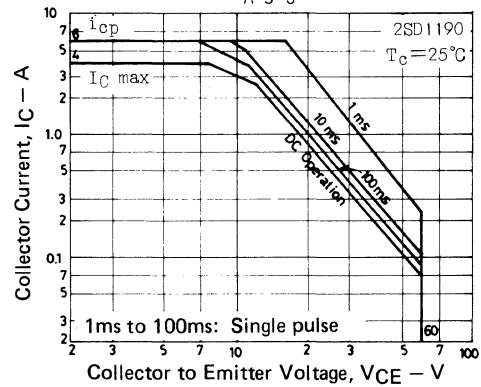
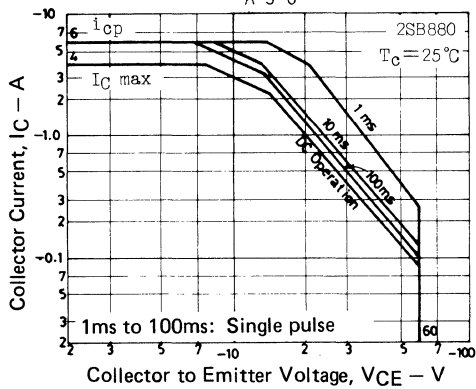
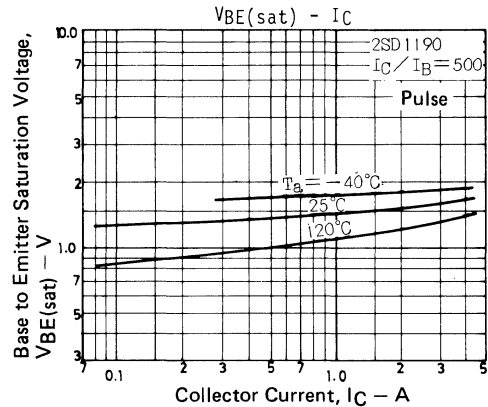
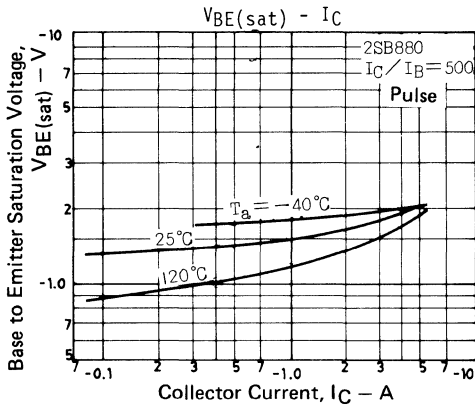
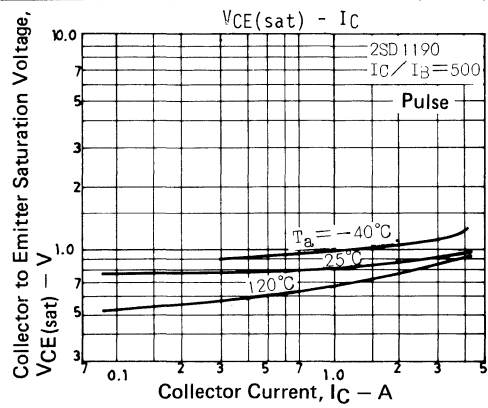
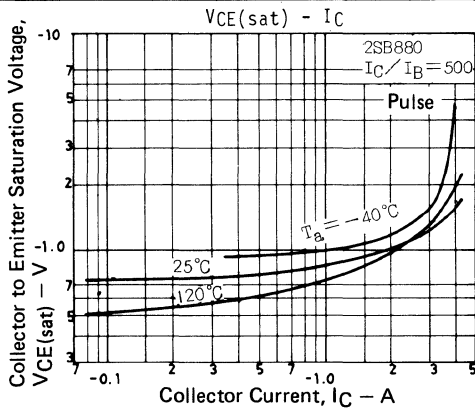


Case Outline 2010A

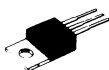
(unit: mm)







2SD1191



2010A

NPN/PNP Epitaxial Planar
Silicon Darlington Transistors

2SB881

Driver Applications

©925B

Applications

- Motor drivers, printer hammer drivers, relay drivers, voltage regulators

Features

- High DC current gain
- Large current capacity and wide ASO
- Low saturation voltage

(): 2SB881

Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$

			unit
Collect to Base Voltage	V_{CB0}	(-) 70	V
Collector to Emitter Voltage	V_{CE0}	(-) 60	V
Emitter to Base Voltage	V_{EB0}	(-) 6	V
Collector Current	I_C	(-) 7	A
Peak Collector Current	i_{cp}	(-) 10	A
Collector Dissipation	P_C	1.75	W
	$T_C=25^{\circ}\text{C}$	-35	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to $+150$	$^{\circ}\text{C}$

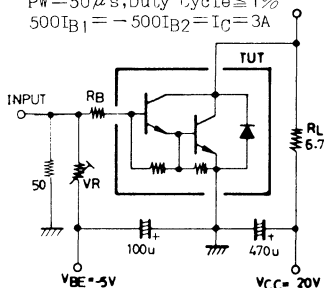
Electrical Characteristics/ $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cut-off Current	I_{CBO}	$V_{CB}=(-)40, I_E=0$			(-) 0.1	mA
Emitter Cut-off Current	I_{EBO}	$V_{EB}=(-)5V, I_C=0$			(-) 3.0	mA
DC Current Gain	h_{FE}	$V_{CE}=(-)2V, I_C=(-)3.5A$	2000	5000		
Gain Band-width Product	f_T	$V_{CE}=(-)5V, I_C=(-)3.5A$		20		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)3.5A, I_B=(-)7mA$		0.9	(-) 1.5	V
				(-) 1.0		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)3.5A, I_B=(-)7mA$			(-) 2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5mA, I_E=0$	(-) 70			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50mA, R_{BE}=\infty$	(-) 60			V
Turn-on Time	t_{on}	At Specified Test Circuit		(0.5) 0.6		μs
Storage Time	t_{stg}	"		(1.5) 3.0		μs
Fall Time	t_f	"		(1.4) 1.7		μs

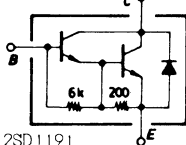
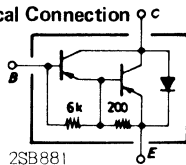
Specified Test Circuit

(For PNP, polarity is reversed.)

$PW=50\mu\text{s}$, Duty Cycle $\leq 1\%$
 $500I_{B1} = -500I_{B2} = I_C = 3A$

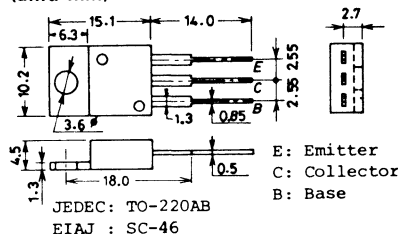


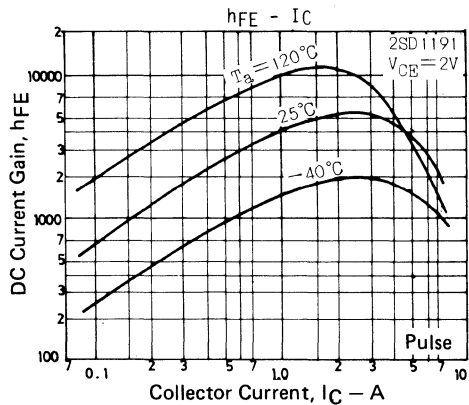
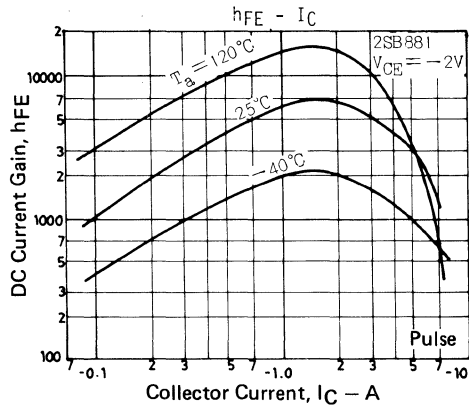
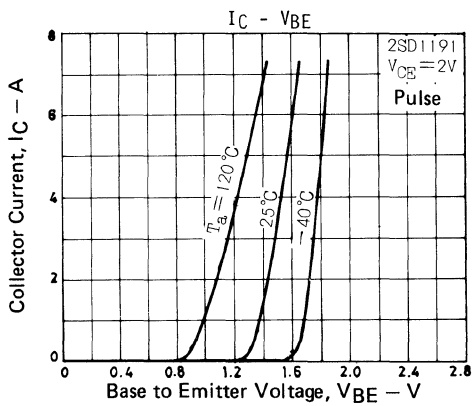
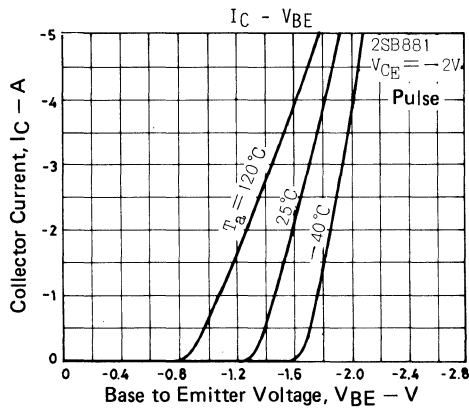
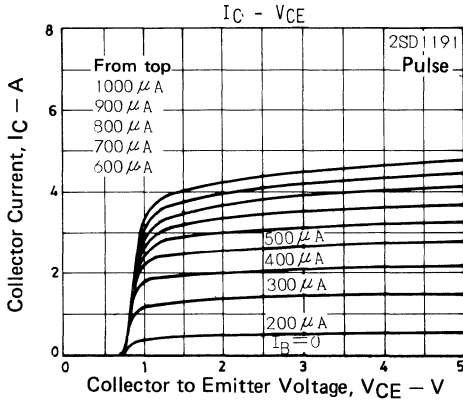
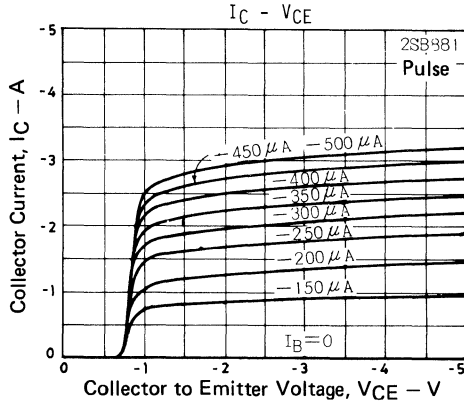
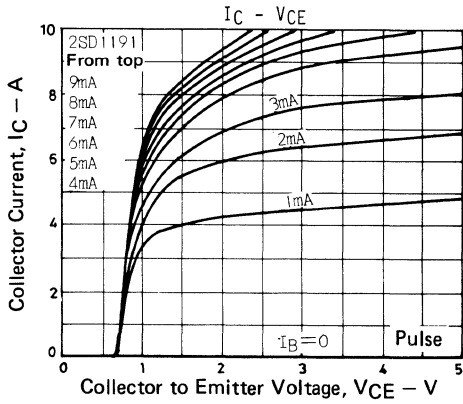
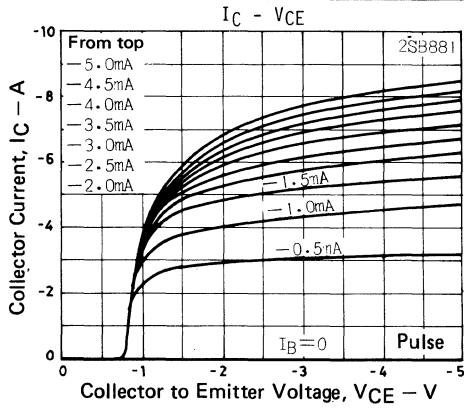
Electrical Connection

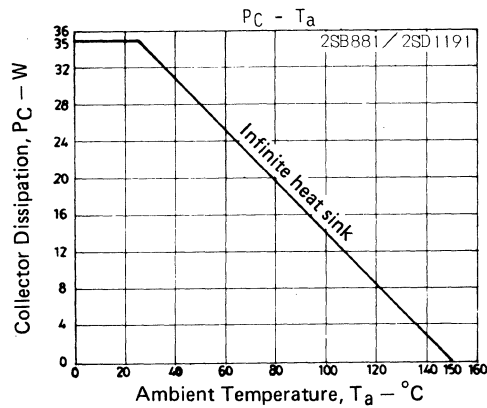
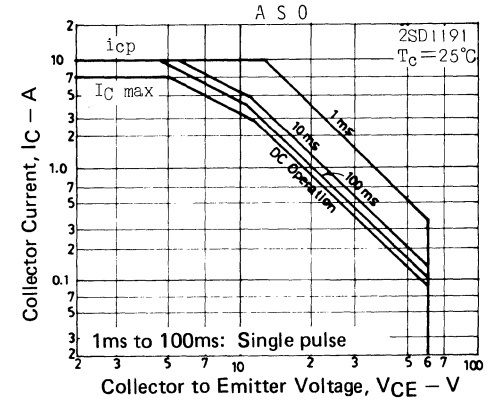
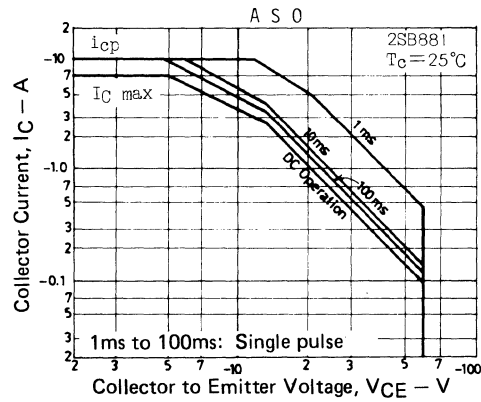
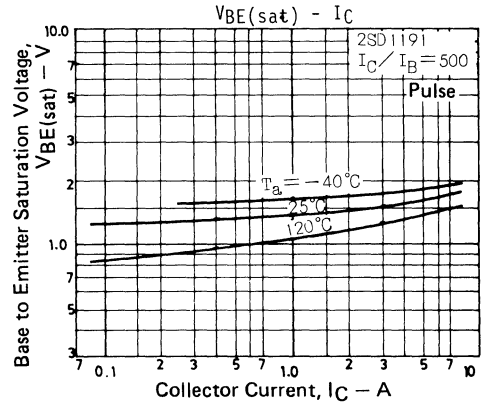
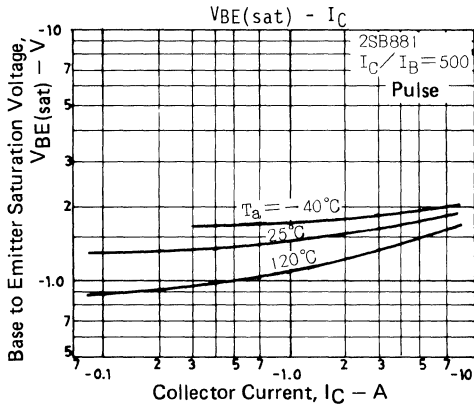
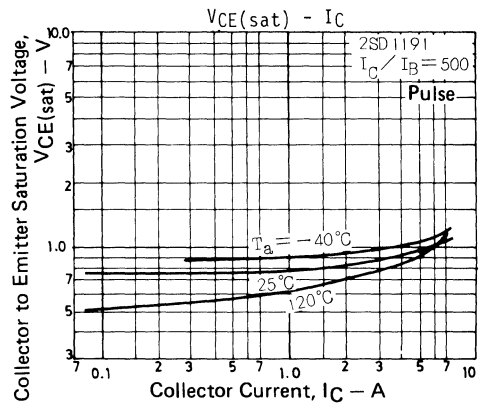
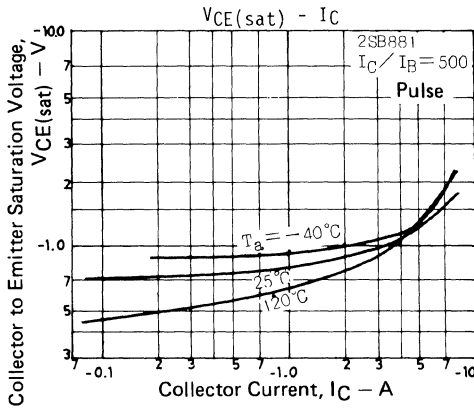


Case Outline 2010A

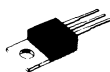
(unit: mm)







2SD1192



2010A

NPN/PNP Epitaxial Planar
Silicon Darlington Transistors

2SB882

Driver Applications

©926A

Applications

- Motor drivers, printer hammer drivers, relay drivers, voltage regulators.

Features

- High DC current gain.
- Large current capacity and wide ASO.
- Low saturation voltage.

(): 2SB882

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)70	V
Collector to Emitter Voltage	V_{CEO}	(-)60	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)10	A
Peak Collector Current	i_{cp}	(-)15	A
Allowable Collector Dissipation	P_C	1.75	W
		40	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-40 to +150	$^{\circ}\text{C}$

$T_C=25^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

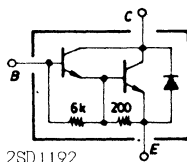
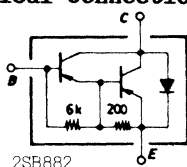
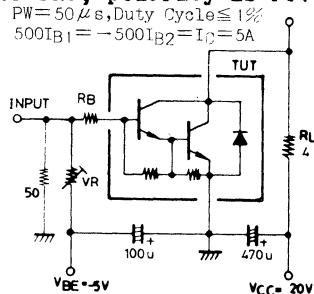
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CE}=(-)40\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EE}=(-)5\text{V}, I_C=0$			(-)3.0	mA
DC Current Gain	h_{FE}	$V_{CE}=(-)2\text{V}, I_C=(-)5\text{A}$	2000	5000		
Gain Bandwidth Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)5\text{A}$		20		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{A}, I_B=(-)10\text{mA}$		0.9(-1.0)	1.5	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)5\text{A}, I_B=(-)10\text{mA}$			(-)2.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)70			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)60			V
Turn-ON Time	t_{on}	At specified Test Circuit	(0.5)	0.6		us
Storage Time	t_{stg}	"	(1.5)	3.0		us
Fall Time	t_f	"	(1.7)	1.8		us

Electrical Connection

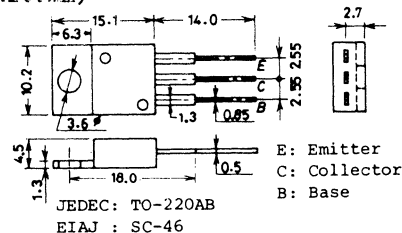
Test Circuit

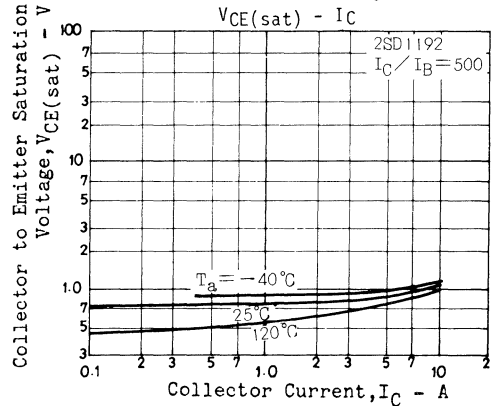
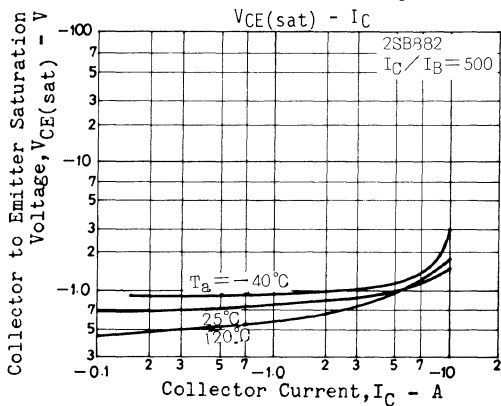
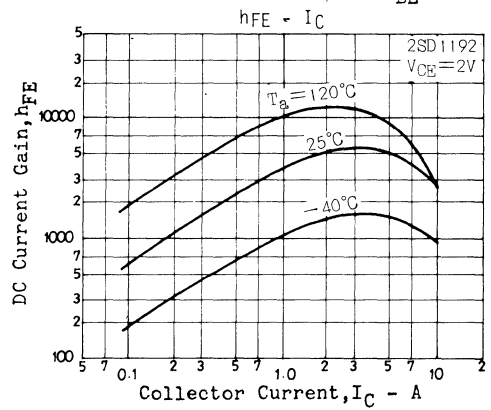
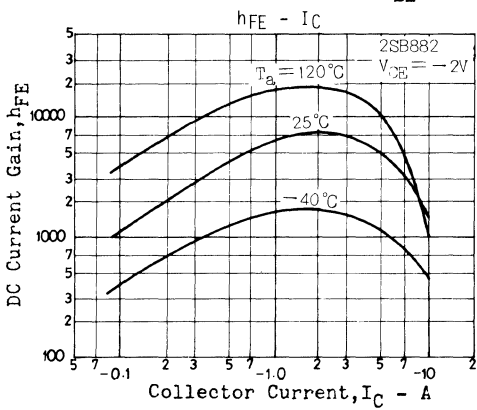
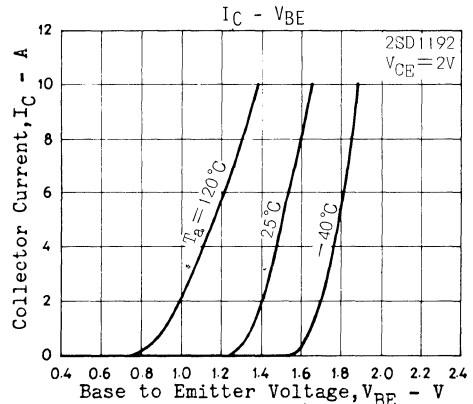
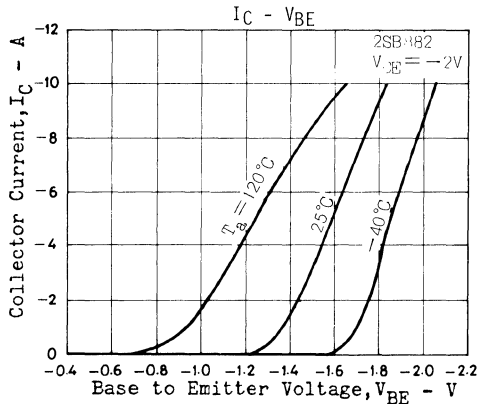
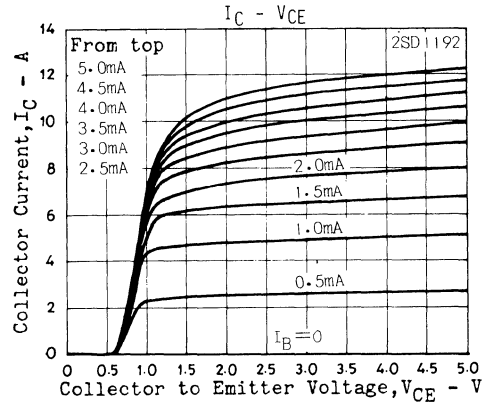
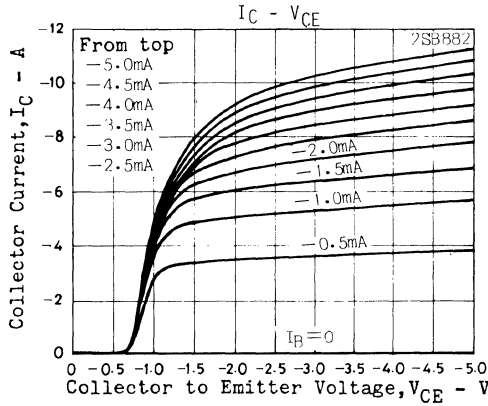
(For PNP, polarity is reversed.)

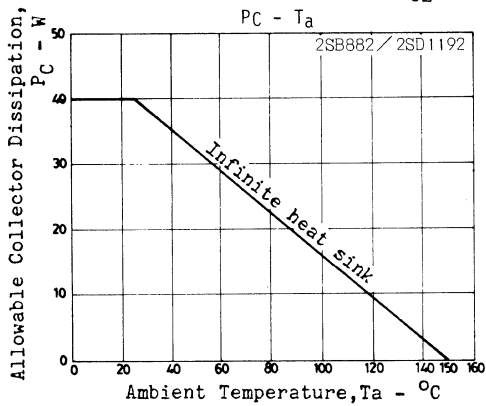
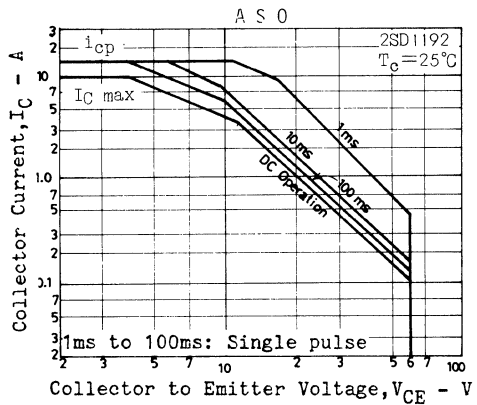
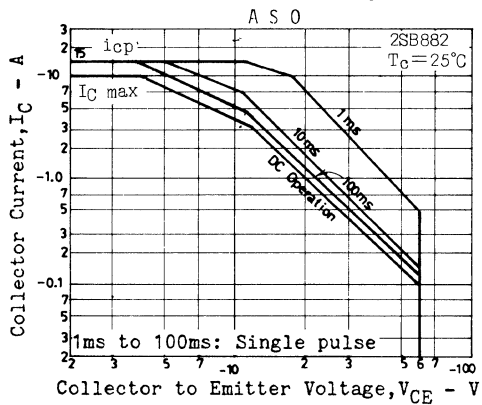
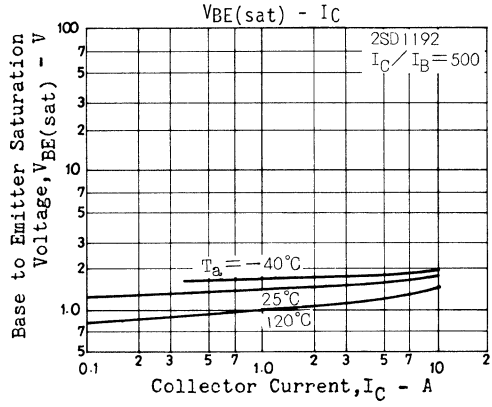
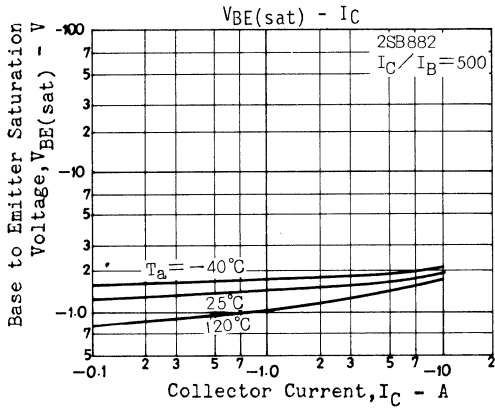
$PW=50\mu\text{s}$, Duty Cycle $\leq 1\%$
 $500I_{B1} = -500I_{B2} = I_C = 5\text{A}$



Case Outline 2010A (unit:mm)







2SD1193



2022

NPN/PNP Epitaxial Planar
Silicon Darlington Transistors

2SB883

Driver Applications

©1036

Uses

- Motor drivers, printer hammer drivers, relay drivers, regulated DC power supply controllers

Features

- High DC current gain
- Large current capacity and wide ASQ
- Low saturation voltage

() : 2SB883

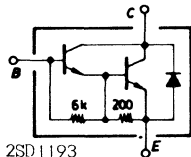
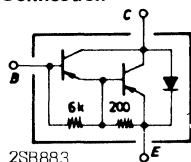
Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)70	V
Collector to Emitter Voltage	V_{CEO}	(-)60	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)15	A
Peak Collector Current	i_{cp}	(-)20	A
Collector Dissipation	P_C	70	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

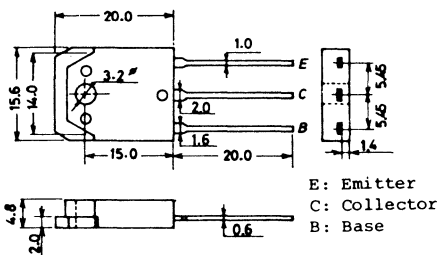
Electrical Characteristics/ $T_a=25^{\circ}\text{C}$

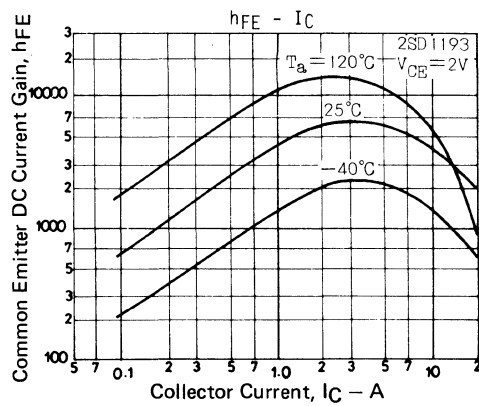
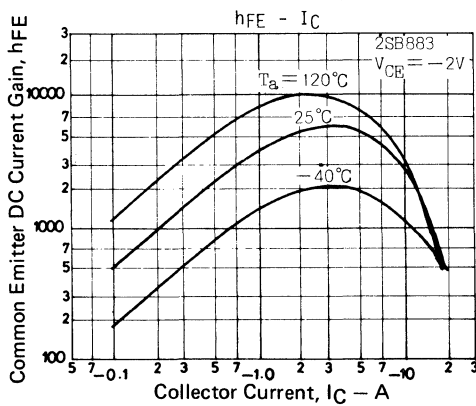
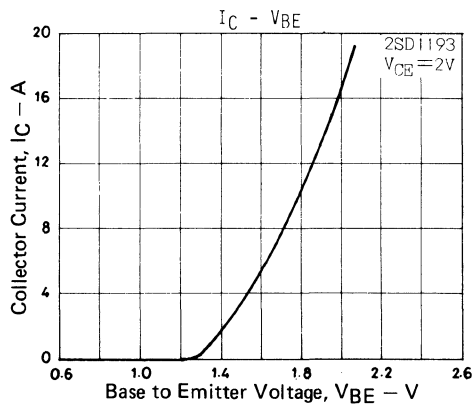
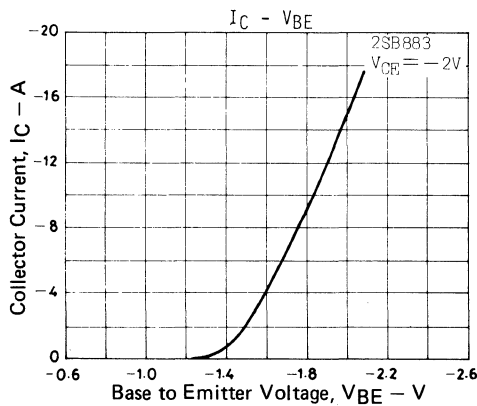
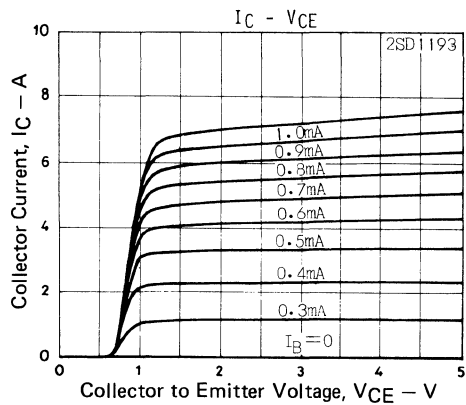
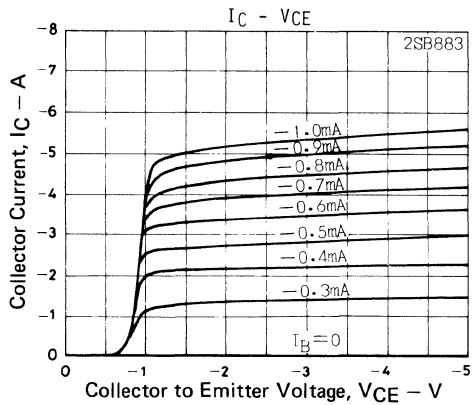
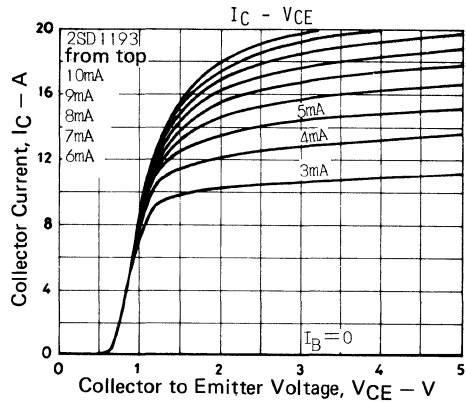
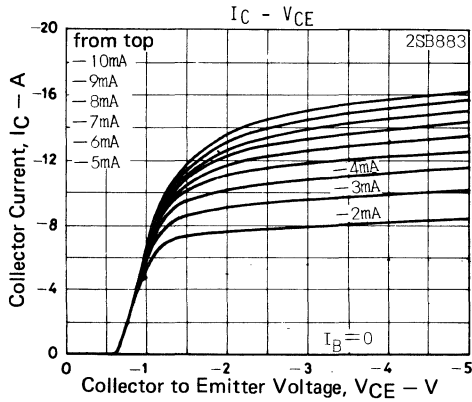
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CE}=(-)40\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$			(-)3	mA
DC Current Gain	h_{FE}	$V_{CE}=(-)2\text{V}, I_C=(-)7\text{A}$	2000	5000		
Gain Band-width Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)7\text{A}$		20		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)7\text{A}, I_B=(-)14\text{mA}$		0.9	(-)1.5	V
				(-1.0)		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)7\text{A}, I_B=(-)14\text{mA}$			(-)2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)70			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)60			V

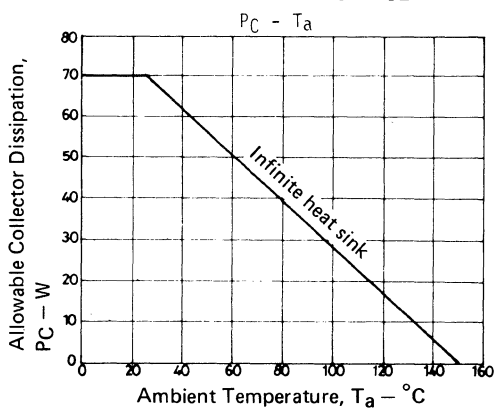
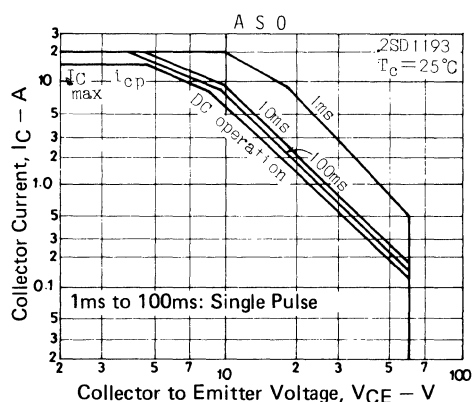
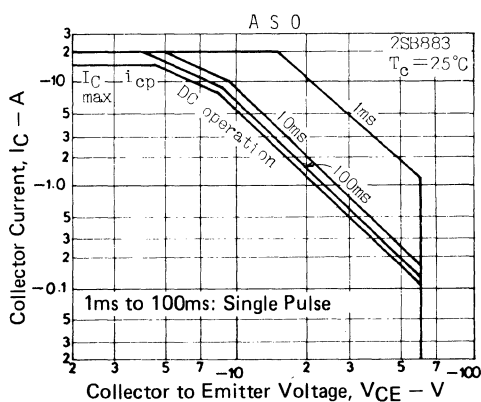
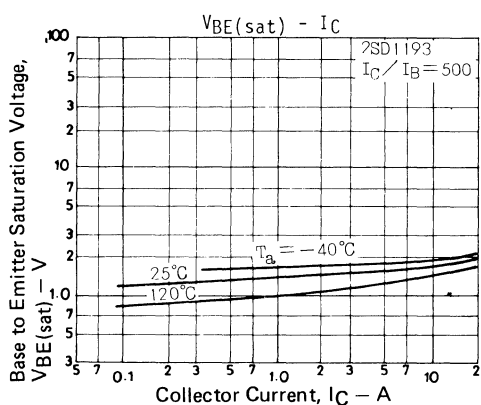
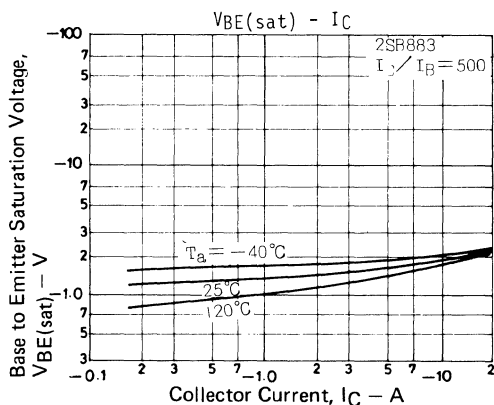
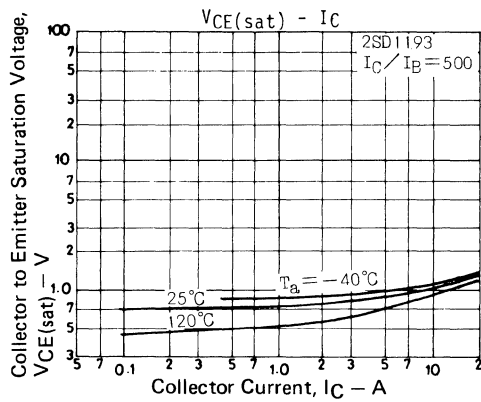
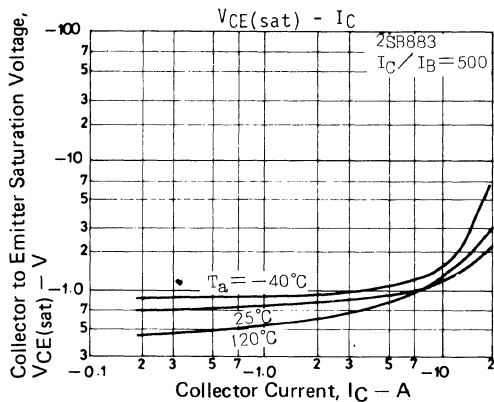
Electrical Connection



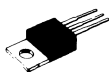
Case Outline 2022 (unit: mm)







2SD1194



2010A

NPN/PNP Planar
Silicon Darlington Transistors

2SB884

Driver Applications

©1018B

Uses

- Motor drivers, printer hammer drivers, relay drivers, regulated DC power supply controllers

Features

- High DC current gain
- Large current capacity and wide ASO
- Low saturation voltage

(): 2SB884

Absolute Maximum Ratings/ $T_a=25^\circ\text{C}$

Absolute Maximum Ratings/T _a =25°C				unit
Collector to Base Voltage	V _{CB0}	(-)110		V
Collector to Emitter Voltage	V _{CEO}	(-)100		V
Emitter to Base Voltage	V _{EB0}	(-)6		V
Collector Current	I _C	(-)3		A
Peak Collector Current	i _{cp}	(-)5		A
Collector Dissipation	P _C	1.75		W
		T _c =25°C	30	W
Junction Temperature	T _j		150	°C
Storage Temperature	T _{sta}		-55 to +150	°C

Electrical Characteristics/ $T_a=25^\circ\text{C}$

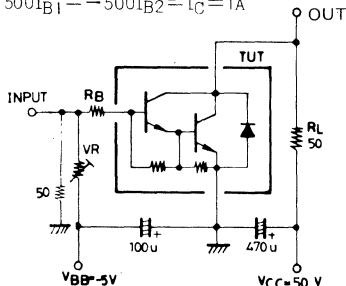
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$			(-)3	mA
Common Emitter DC Current Gain	h_{FE}	$V_{CE}=(-)3\text{V}, I_C=(-)1.5\text{A}$	1500	4000		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)1.5\text{A}, I_B=(-)3\text{mA}$		0.9	(-)1.5	V
				(-1.0)		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)1.5\text{A}, I_B=(-)3\text{mA}$			(-)2.0	V
Gain Band-width Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)1.5\text{A}$		20		MHz
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)110			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)100			V
Turn-on Time	t_{on}	at Specified Test Circuit		(0.8)0.7		μs
Storage Time	T_{stg}	"		(2.4)5.0		μs
Fall Time	t_f	"		(1.2)1.2		μs

Specified Test Circuit

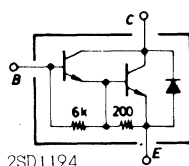
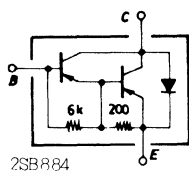
(For PNP, the polarity is reversed.)

$PW=50\mu\text{s}, \text{Duty Cycle}\leq 1\%$

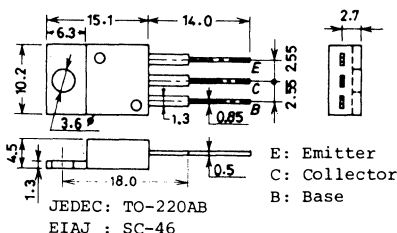
$500I_{B1}=-500I_{B2}=I_C=1\text{A}$

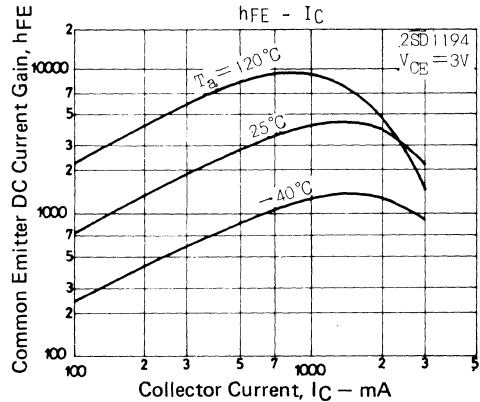
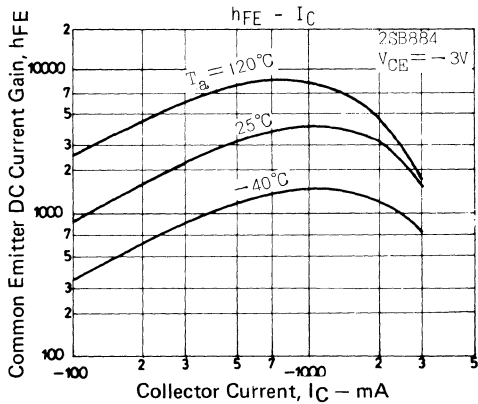
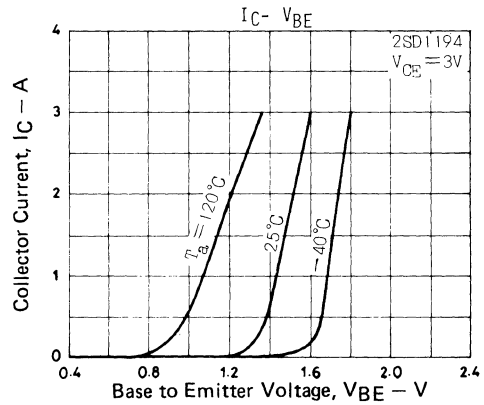
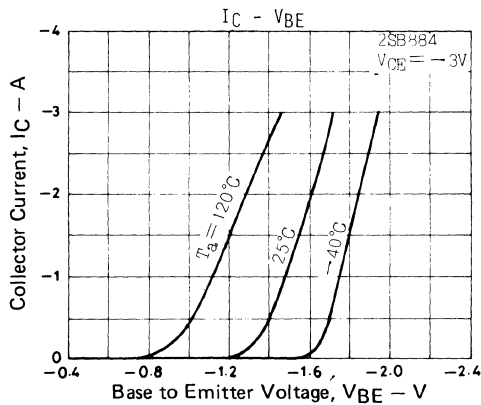
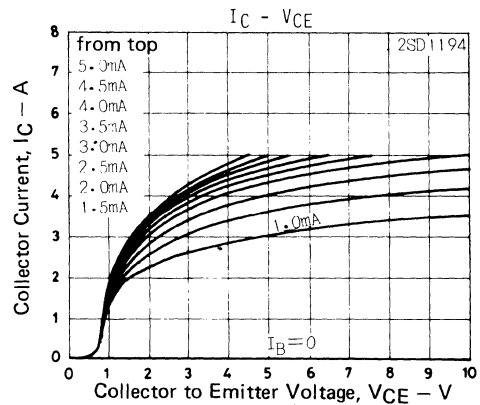
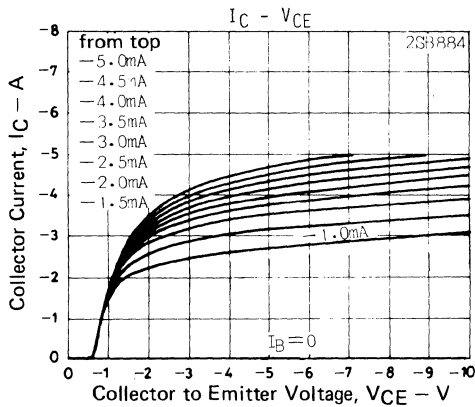
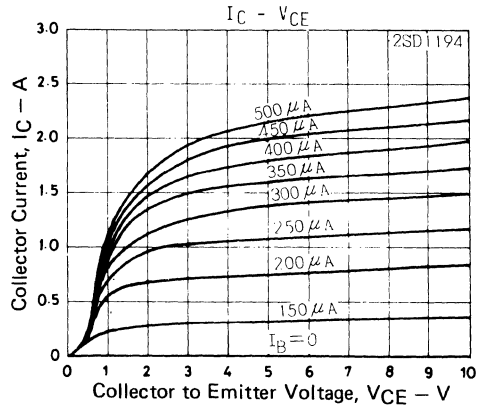
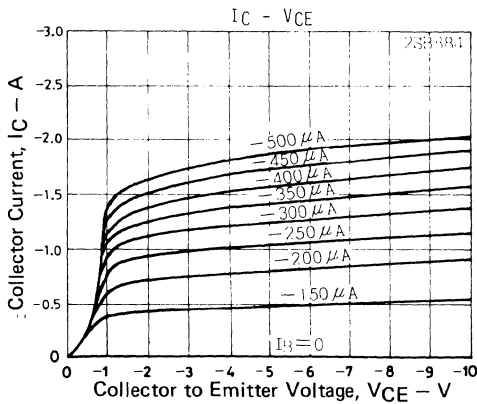


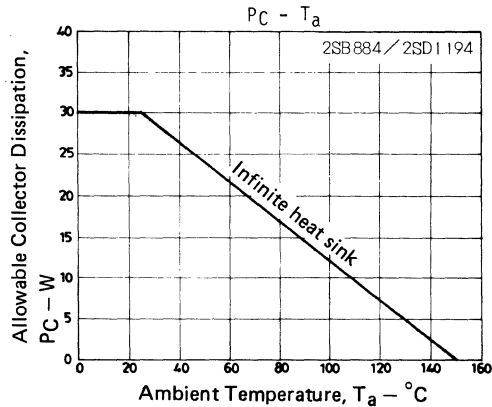
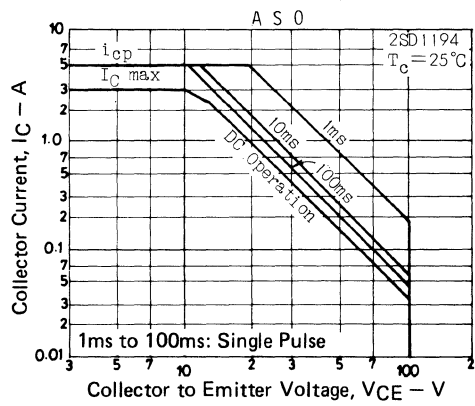
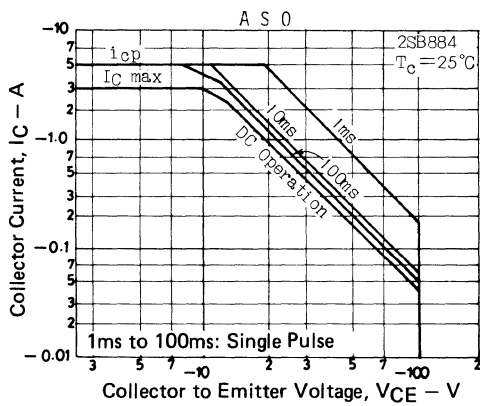
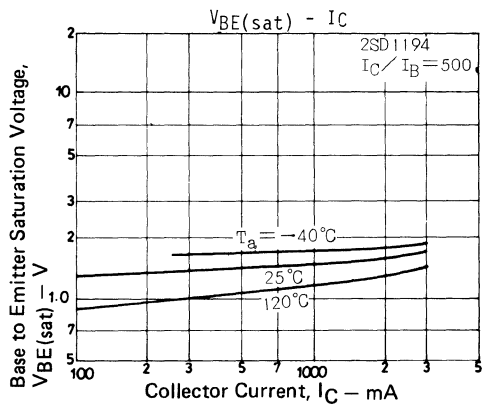
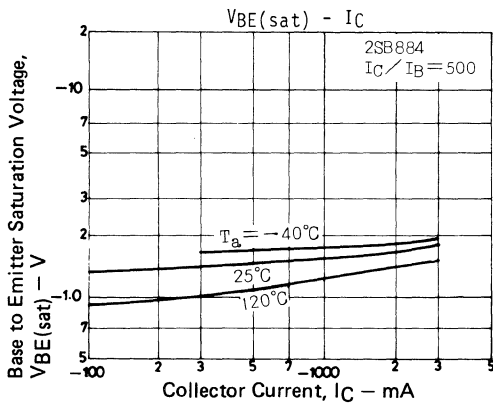
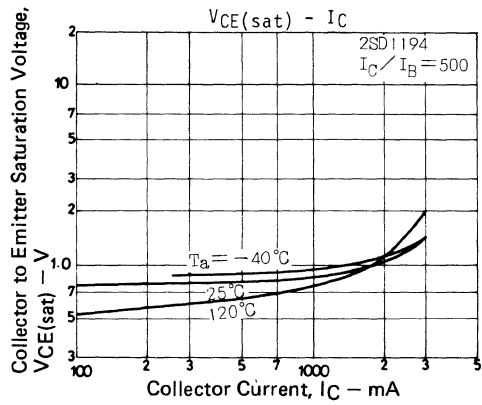
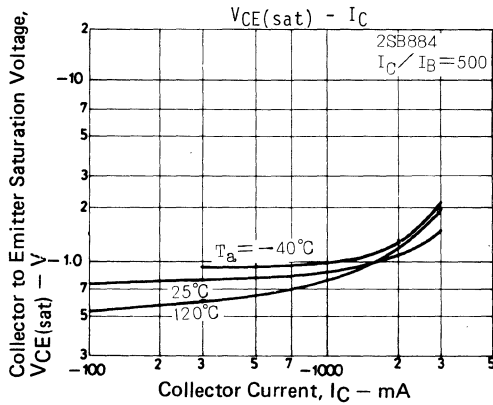
Electrical Connection



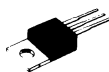
Case Outline 2010A (unit: mm)







2SD1195



2010A

NPN/PNP Planar
Silicon Darlington Transistors

2SB885

Driver Applications

©927B

Uses

- Motor drivers, printer hammer drivers, relay drivers, constant voltage power supply controllers

Features

- High DC current gain
- Large current capacity and wide ASO
- Low saturation voltage

(): 2SB885

Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$

Absolute Maximum Ratings/T _a =25°C				unit
Collector to Base Voltage	V _{CBO}	(-)110		V
Collector to Emitter Voltage	V _{CEO}	(-)100		V
Emitter to Base Voltage	V _{EBO}	(-)6		V
Collector Current	I _C	(-)5		A
Peak Collector Current	i _{cp}	(-)8		A
Collector Dissipation	P _C	1.75		W
		T _C =25°C	35	W
Junction Temperature	T _j	150		°C
Storage Temperature	T _{stg}	-55 to +150		°C

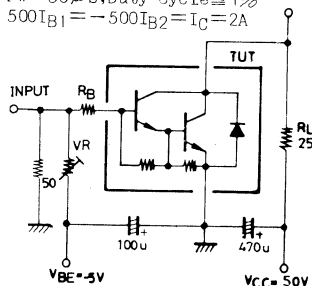
Electrical Characteristics/ $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$			(-)3.0	mA
DC Current Gain	h_{FE}	$V_{CE}=(-)3\text{V}, I_C=(-)2.5\text{A}$	1500	4000		
Gain Band-width Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)2.5\text{A}$		20		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)2.5\text{A}, I_B=(-)5\text{mA}$		0.9	(-)1.5	V
				(-1.0)		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)2.5\text{A}, I_B=(-)5\text{mA}$			(-)2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)110			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)100			V
Turn-on Time	t_{on}	at Specified Test Circuit	(0.7)0.6			μs
Storage Time	t_{stg}	"	(1.3)4.8			μs
Fall Time	t_f	"	(1.5)1.6			μs

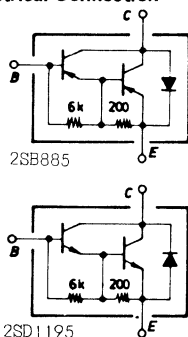
Specified Test Circuit

(For PNP, the polarity is reversed.)

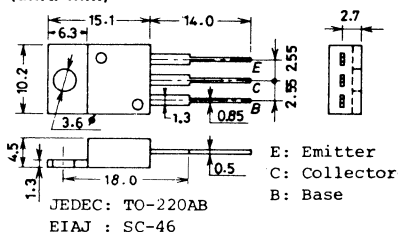
$PW=50\mu\text{s}$, Duty Cycle $\leq 1\%$
 $500I_{B1}=-500I_{B2}=I_C=2\text{A}$

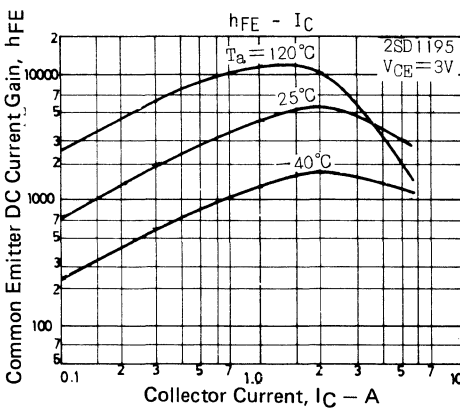
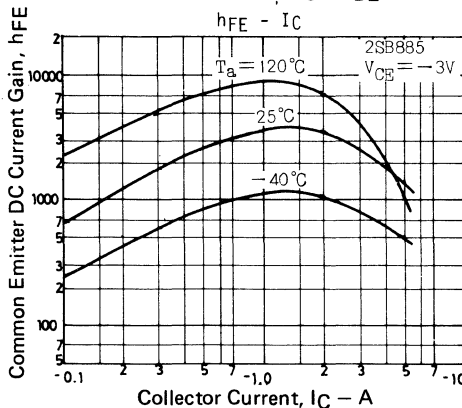
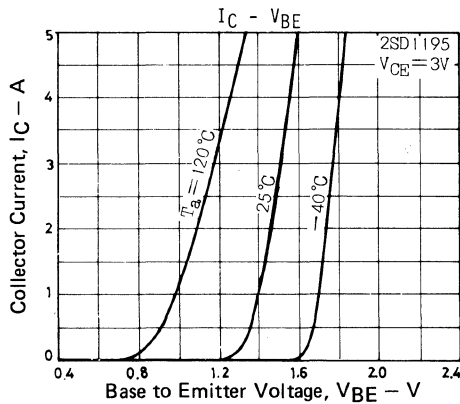
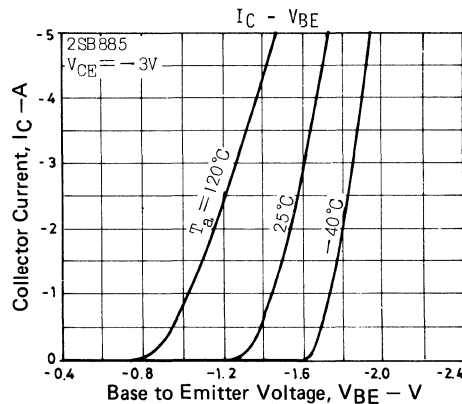
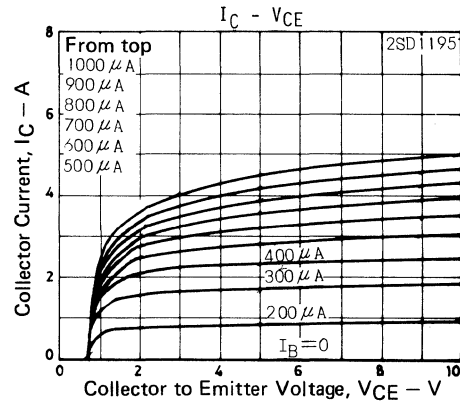
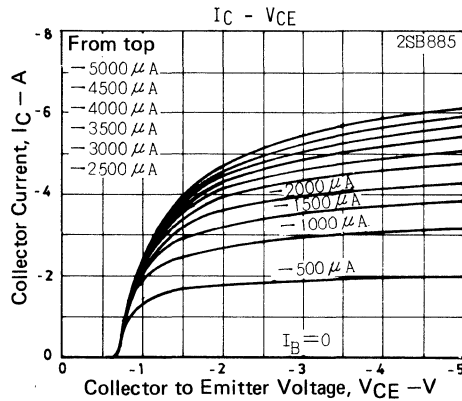
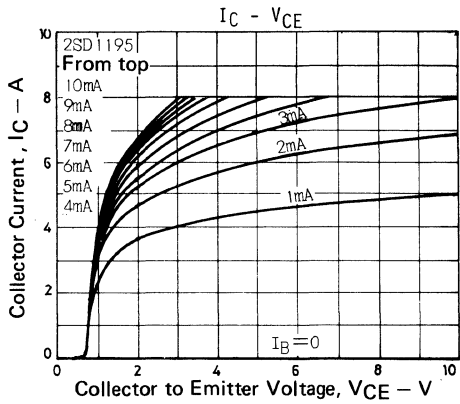
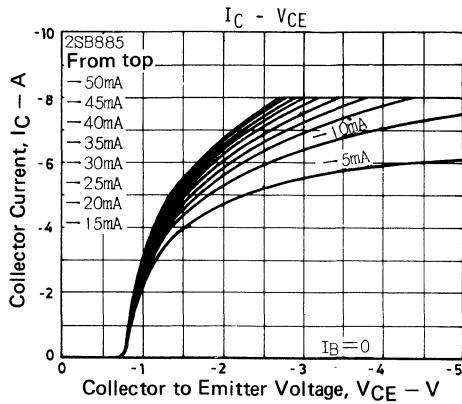


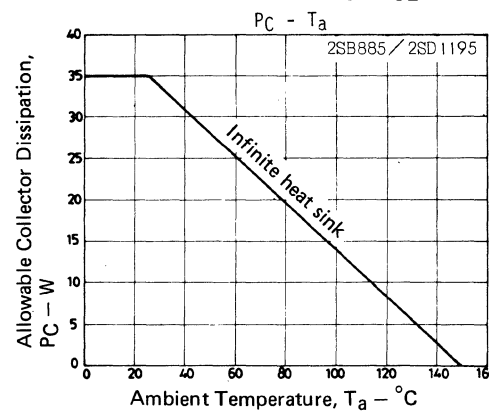
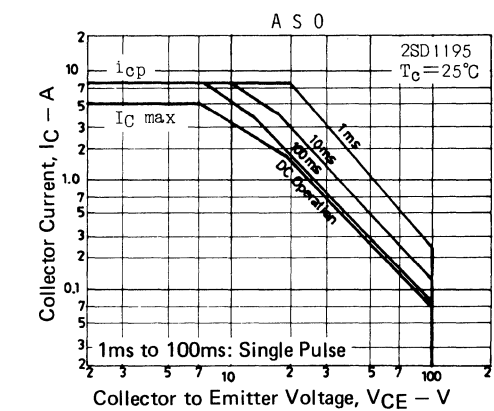
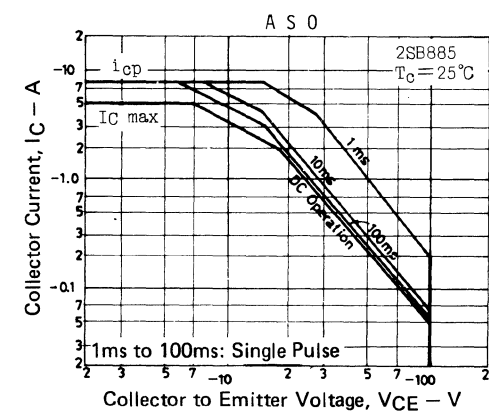
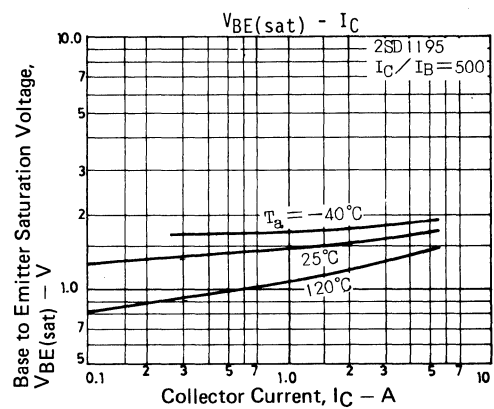
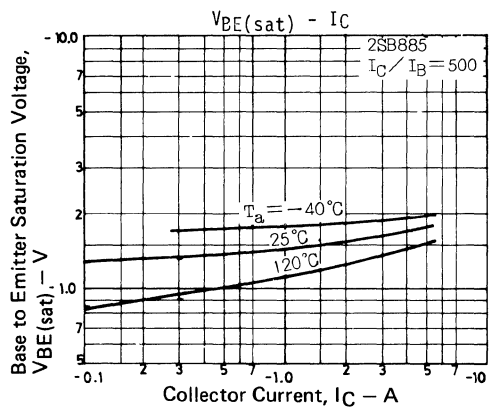
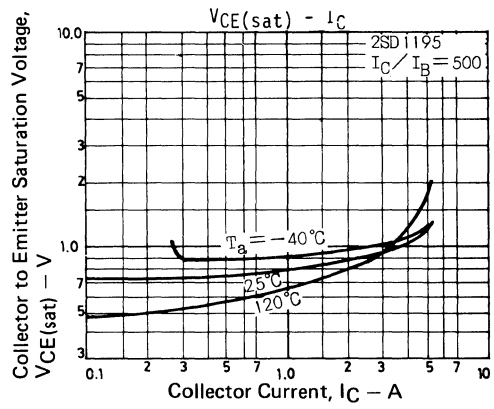
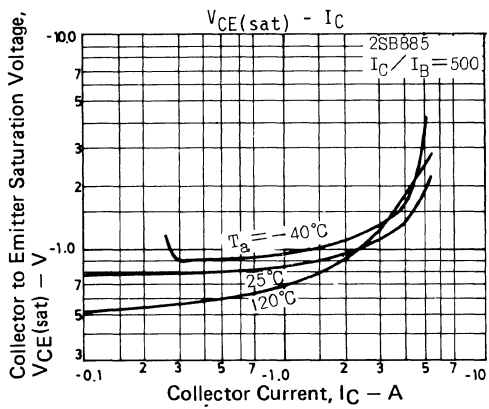
Electrical Connection



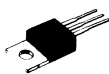
Case Outline 2010A (unit: mm)







2SD1196



2010A

NPN/PNP Planar
Silicon Darlington Transistors

2SB886

Driver Applications

©928

Applications

- . Motor drivers, printer hammer drivers, relay drivers, voltage regulators.

Features

- . High DC current gain.
- . Large current capacity and wide ASO.
- . Low saturation voltage.

(): 2SB886

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-)110	V
Collector to Emitter Voltage	V_{CEO}	(-)100	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)8	A
Peak Collector Current	i_{cp}	(-)12	A
Allowable Collector Dissipation	P_C	1.75	W
		40	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-40 to +150	$^{\circ}\text{C}$

$T_C=25^{\circ}\text{C}$

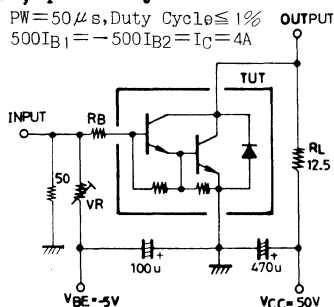
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

		min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80\text{V}, I_E=0$	(-)0.1		mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$	(-)3.0		mA
DC Current Gain	h_{FE}	$V_{CE}=(-)3\text{V}, I_C=(-)4\text{A}$	1500	4000	
Gain Bandwidth Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)4\text{A}$	20		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)4\text{A}, I_B=(-)8\text{mA}$	0.9(-)1.5		V
			(-1.0)		
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)4\text{A}, I_B=(-)8\text{mA}$	(-)2.0		V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)110		V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)100		V
Turn-ON Time	t_{on}	At specified Test Circuit	(0.7) 0.6		us
Storage Time	t_{stg}	"	(1.4) 4.8		us
Fall Time	t_f	"	(1.5) 1.6		us

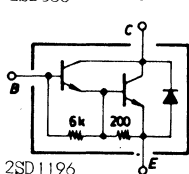
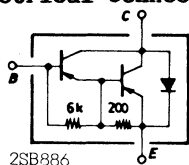
Test Circuit

(For PNP, polarity is reversed.)

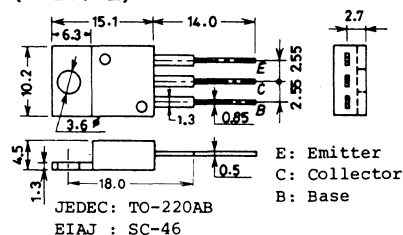
$PW=50\mu\text{s}$, Duty Cycle $\leq 1\%$
 $500I_{B1} = -500I_{B2} = I_C = 4\text{A}$



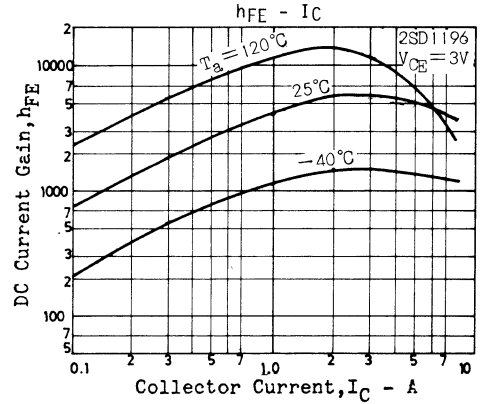
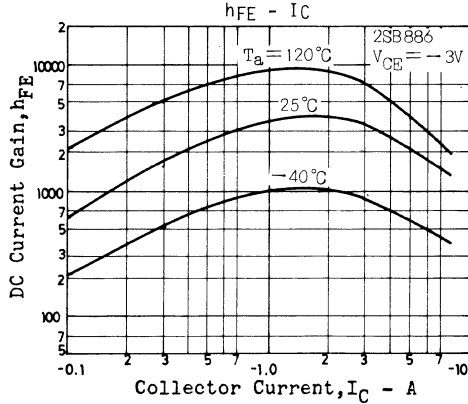
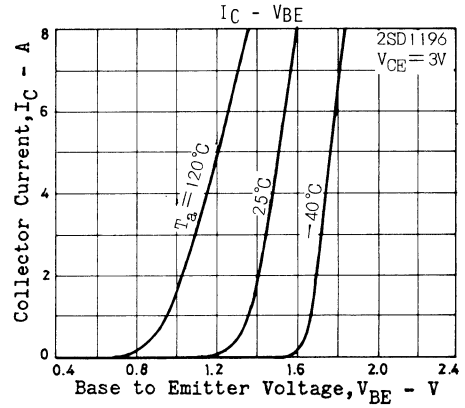
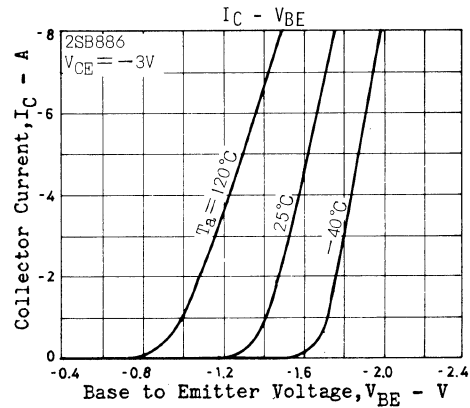
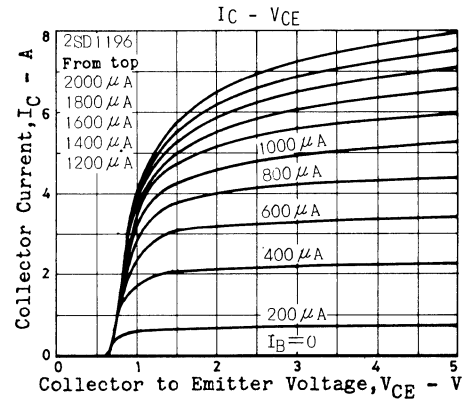
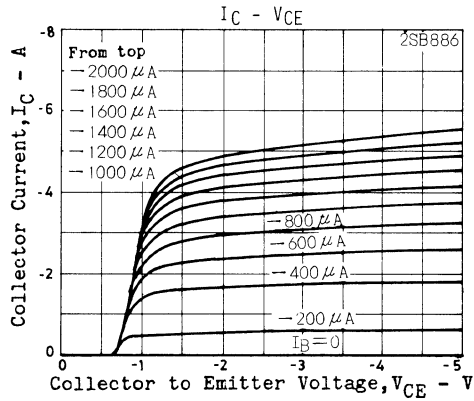
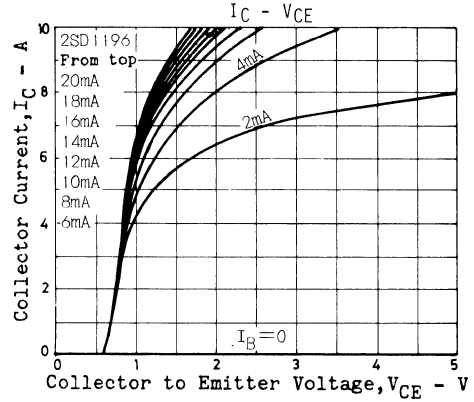
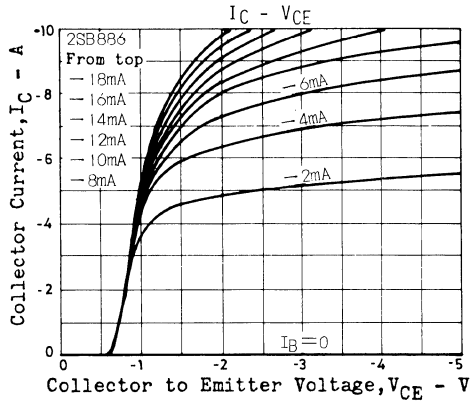
Electrical Connection

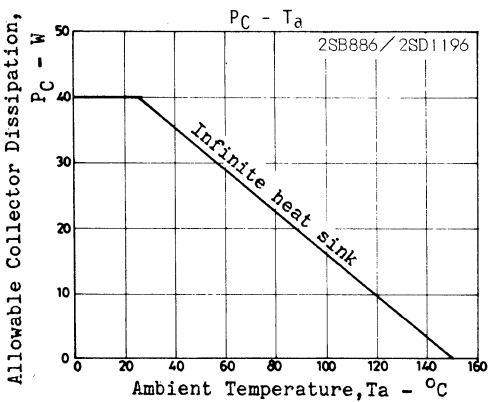
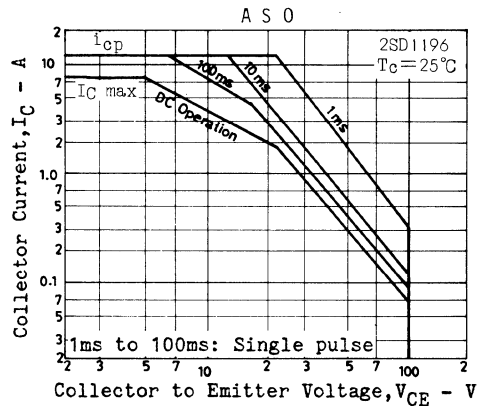
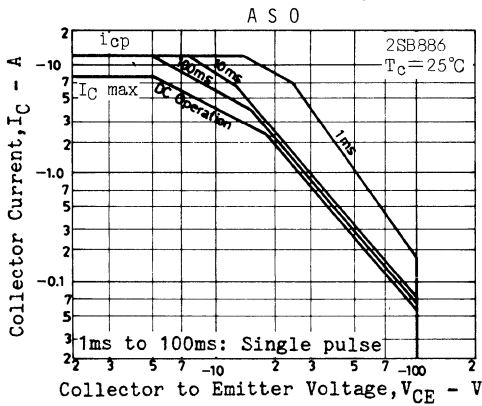
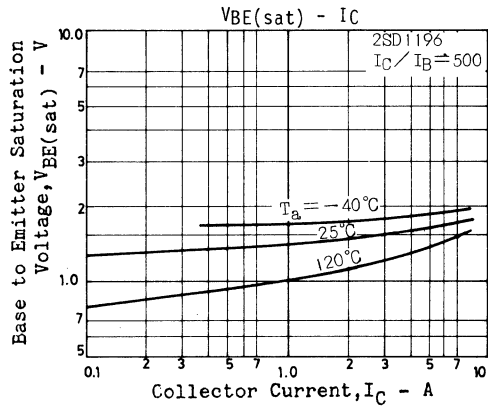
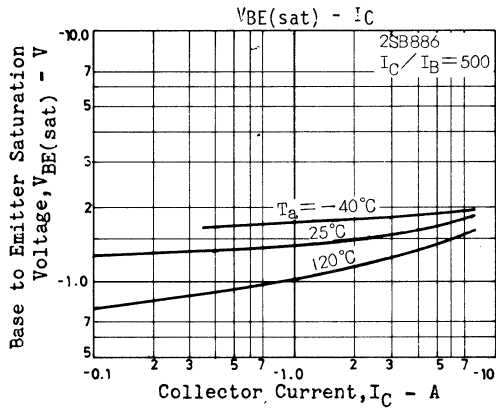
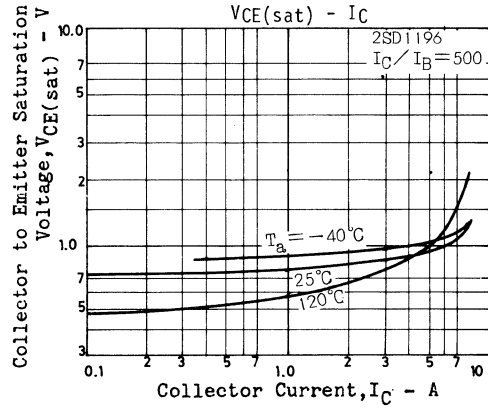
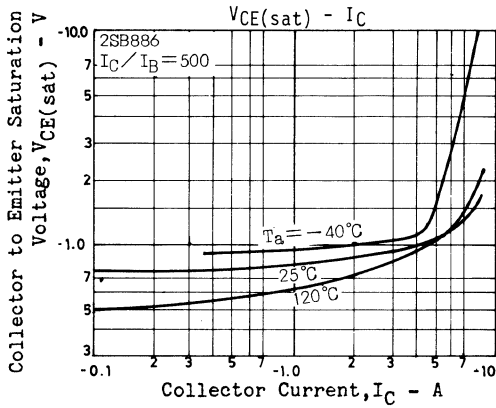


Case Outline 2010A (unit:mm)



E: Emitter
C: Collector
B: Base





2SD1197



2022

NPN/PNP Planar
Silicon Darlington Transistors**2SB887**

Driver Applications

©1079

Uses

- Motor drivers, printer hammer drivers, relay drivers, constant voltage power supply controllers

Features

- High DC current gain
- Large current capacity and wide ASO
- Low saturation voltage

(): 2SB887

Absolute Maximum Ratings/ $T_a=25^{\circ}\text{C}$

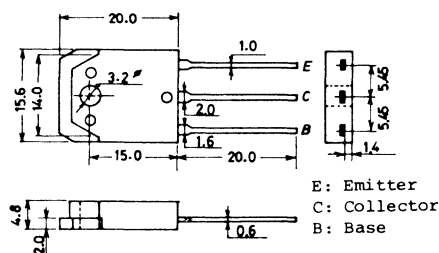
			unit
Collector to Base Voltage	V_{CBO}	(-)110	V
Collector to Emitter Voltage	V_{CEO}	(-)100	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)10	A
Peak Collector Current	i_{cp}	(-)15	A
Collector Dissipation	P_C	70	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics/ $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80\text{V}, I_E=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$			(-)3.0	mA
Common Emitter DC Current Gain	h_{FE}	$V_{CE}=(-)3\text{V}, I_C=(-)5\text{A}$	1500	4000		
Gain Band-width Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)5\text{A}$		20		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)5\text{A}, I_B=(-)10\text{mA}$		(-1.0)	(-)1.5	V
				0.9		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)5\text{A}, I_B=(-)10\text{mA}$			(-)2.0	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)5\text{mA}, I_E=0$	(-)110			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)50\text{mA}, R_{BE}=\infty$	(-)100			V

Case Outline 2022

(unit: mm)



2SD1207



2006A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB892

High Current Switching Applications

©930B

APPLICATIONS

- Power supplies, relay drivers, lamp drivers, and automotive wiring

FEATURES

- FBET and MBIT processed (Original process of SANYO)
- Low saturation voltage
- Large current capacity and wide ASO

Values for 2SB892 shown in ()

ABSOLUTE MAXIMUM RATINGS/ $T_a=25^{\circ}\text{C}$

			unit
Collector to base voltage	V_{CBO}	(-)60	V
Collector to emitter voltage	V_{CEO}	(-)50	V
Emitter to base voltage	V_{EBO}	(-)6	V
Collector current	I_C	(-)2	A
Peak collector current	i_{cp}	(-)4	A
Allowable collector dissipation	P_C	1	W
Junction temperature	T_j	150	$^{\circ}\text{C}$
Storage ambient temperature	T_{stg}	-55~+150	$^{\circ}\text{C}$

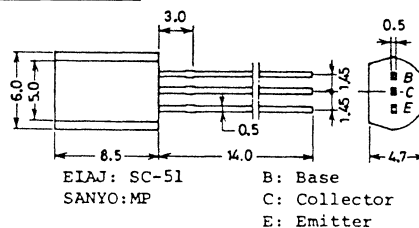
ELECTRICAL CHARACTERISTICS/ $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector cut-off current	I_{CBO}	$V_{CB}=(-)50\text{V}, I_E=0$			(-)0.1	μA
Emitter cut-off current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	μA
DC current gain	$h_{FE(1)*}$	$V_{CE}=(-)2\text{V}, I_C=(-)100\text{mA}$	100		560	
	$h_{FE(2)}$	$V_{CE}=(-)2\text{V}, I_C=(-)1.5\text{A}$	40			
Gain bandwidth product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		150		MHz
Output capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		12		pF
				(22)		pF
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C=(-)1\text{A}, I_B=(-)50\text{mA}$		0.15	0.4	V
				(-0.3)	(-0.7)	V
Base-emitter saturation voltage	$V_{BE(sat)}$	$I_C=(-)1\text{A}, I_B=(-)50\text{mA}$		(-)0.9	(-)1.2	V
Collector-base breakdown voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$	(-)60			V
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$	(-)50			V
Emitter-base breakdown voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$	(-)6			V

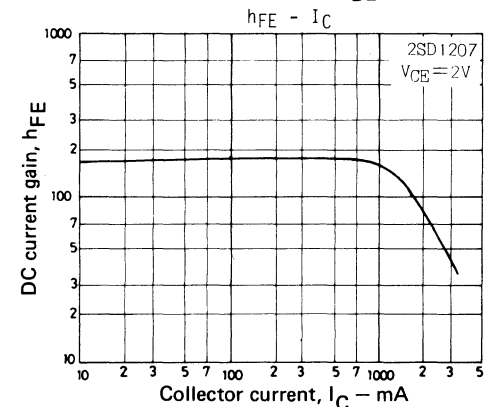
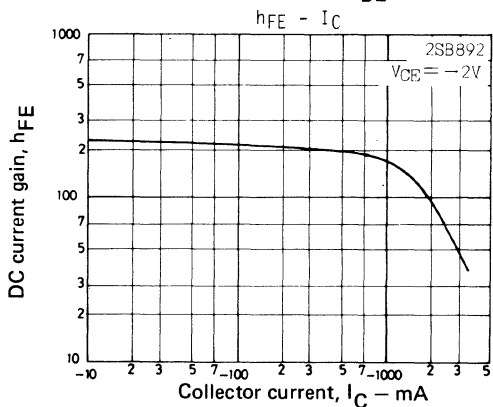
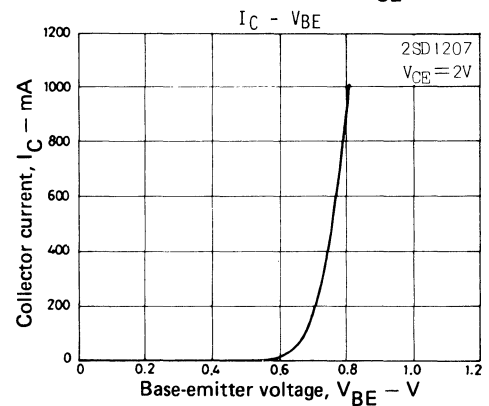
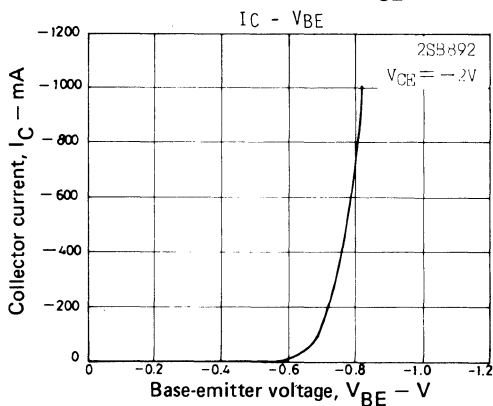
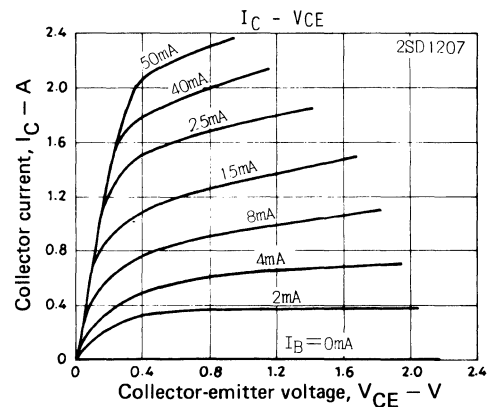
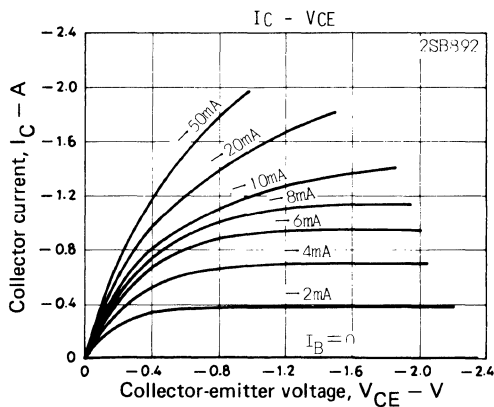
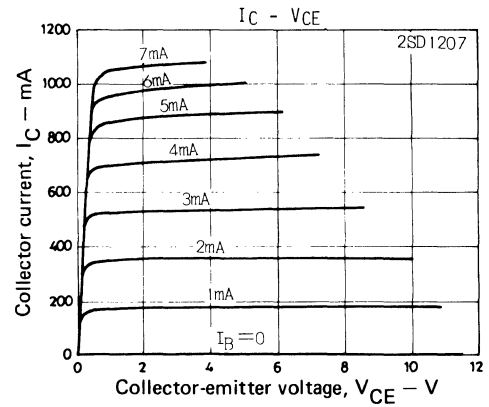
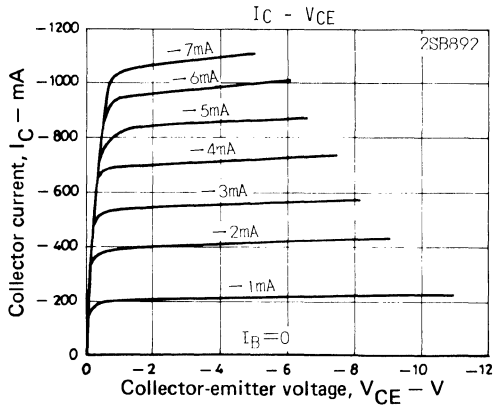
* 2SB892 and 2SD1207 are graded as follows by h_{FE} at 100mA:

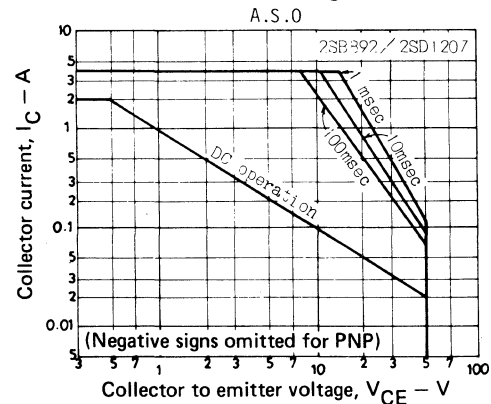
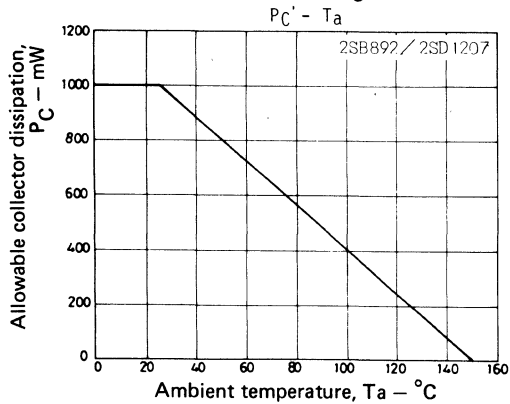
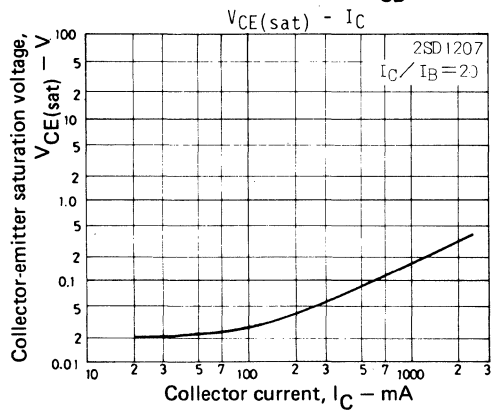
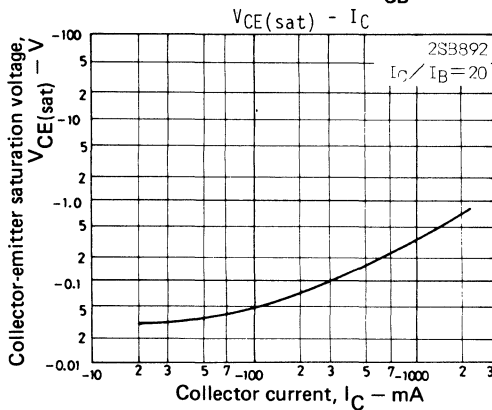
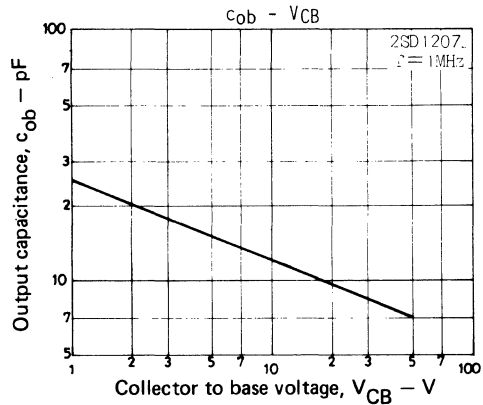
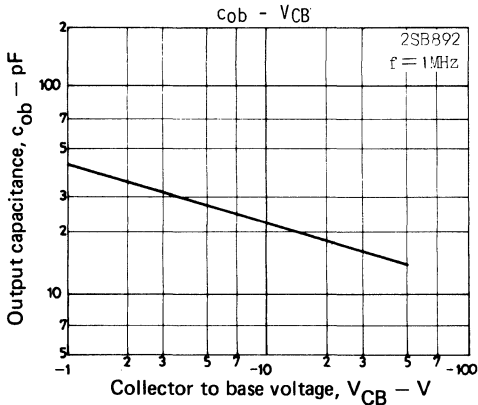
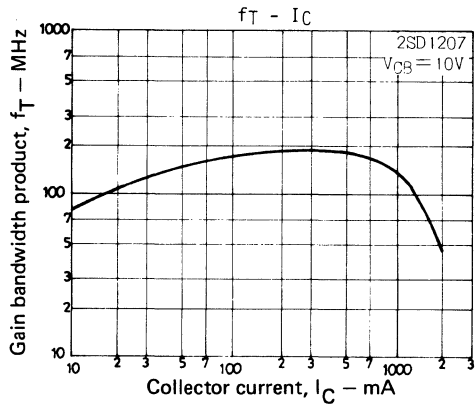
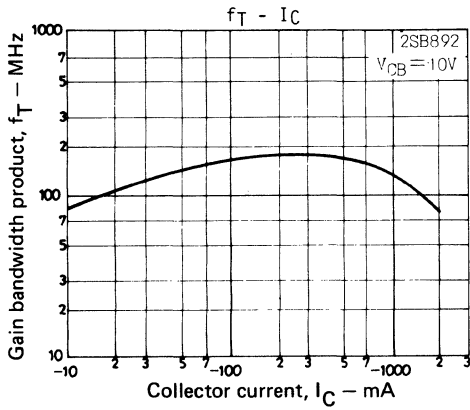
100	R	200	140	S	280	200	T	400	280	U	560
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Case outline 2006A
(unit: mm)

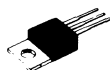


3145KI/No.930-1/3





2SD1212



2010A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB903

High Current Switching Applications

©990A

APPLICATIONS

- Suitable for relay drivers, high-speed inverters, converters, and other general large-current switching applications

FEATURES

- Low collector-emitter saturation voltage: $V_{CE(sat)} = (-)0.5V(\text{PNP}), 0.4V(\text{NPN})$ max.
- Large current capacity

Values for 2SB903 shown in ()

ABSOLUTE MAXIMUM RATINGS/ $T_a = 25^\circ\text{C}$

SOLUTE MAXIMUM RATINGS/Ta=25°C			unit	
Collector to base voltage	V _{CBO}	(-)60	V	
Collector to emitter voltage	V _{CEO}	(-)30	V	
Emitter to base voltage	V _{EBO}	(-)6	V	
Collector current	I _C	(-)12	A	
Peak collector current	i _{cp}	(-)20	A	
Allowable collector dissipation	P _C	1.75	W	
		T _c =25°C	35	W
Junction temperature	T _j	150	°C	
Storage ambient temperature	T _{sta}	-55~+150	°C	

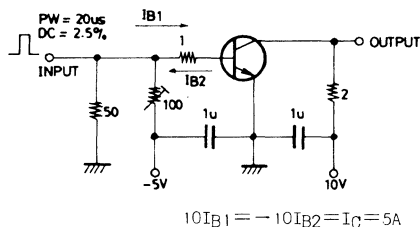
ELECTRICAL CHARACTERISTICS/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Collector cut-off current	I_{CBO}	$V_{CB} = (-)40V, I_E = 0$			(-)0.1	mA
Emitter cut-off current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$			(-)0.1	mA
DC current gain	$h_{FE}(1)^*$	$V_{CE} = (-)2V, I_C = (-)1A$	70*		280*	
	$h_{FE}(2)$	$V_{CE} = (-)2V, I_C = (-)6A$	30			
Gain bandwidth product	f_T	$V_{CE} = (-)5V, I_C = (-)1A$		120		MHz
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C = (-)5A, I_B = (-)0.25A$			(-0.5)	V
					0.4	V
Collector-base breakdown voltage	$V_{(BR)CBO}$	$I_C = (-)1mA, I_E = 0$	(-)60			V
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-)30			V
Emitter-base breakdown voltage	$V_{(BR)EBO}$	$I_E = (-)1mA, I_C = 0$	(-)6			V
Turn-on time	t_{on}	at the appointed circuit		(0.1)0.2		μs
Storage time	t_{stg}	at the appointed circuit		(0.3)0.5		μs
Fall time	t_f	at the appointed circuit		0.03		μs

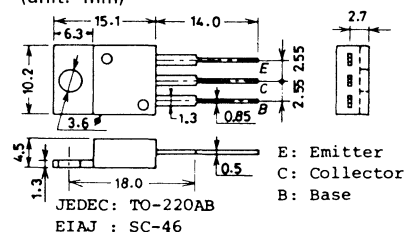
* 2SB903 and 2SD1212 are graded as follows by h_{FE} at 1A:

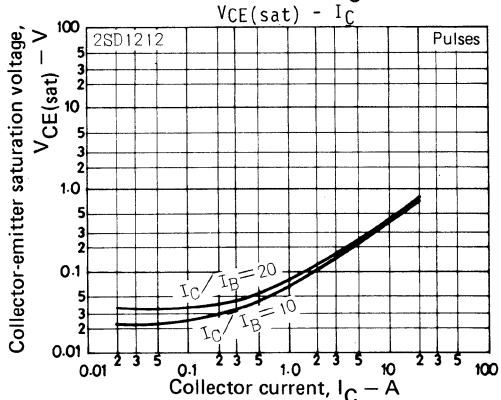
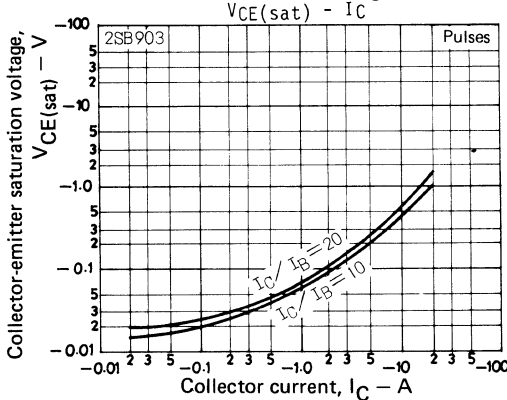
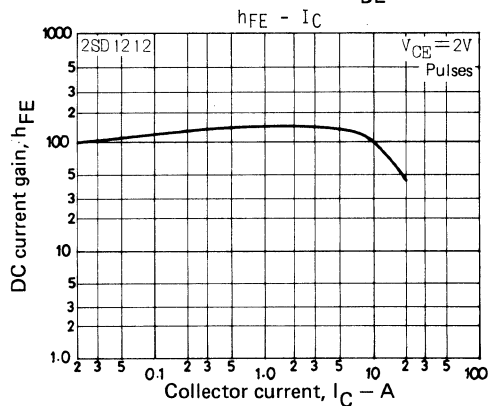
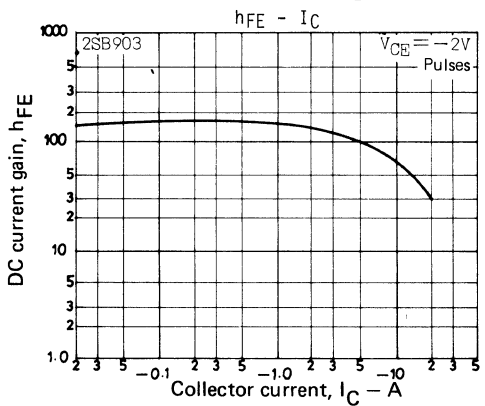
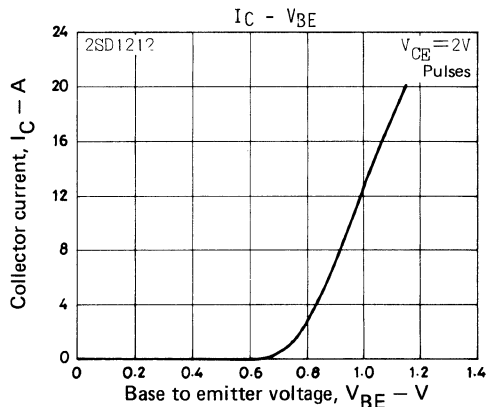
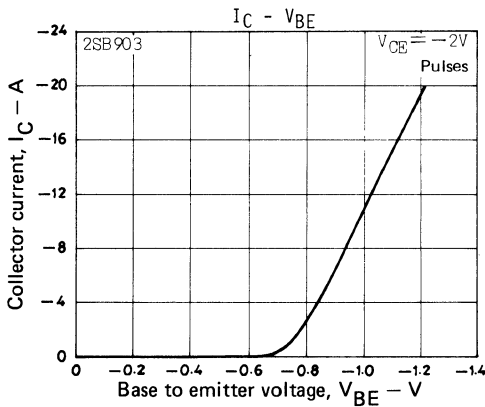
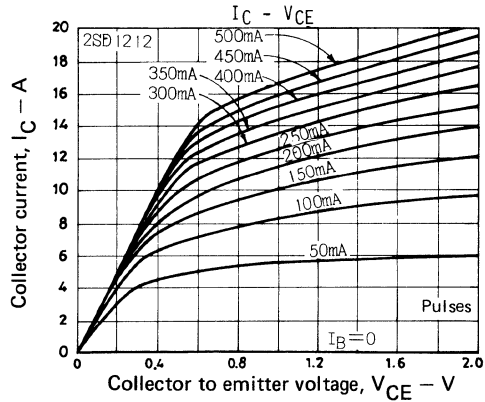
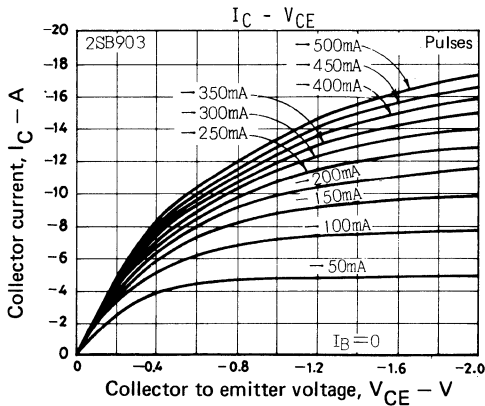
70	Q	140	100	R	200	140	S	280
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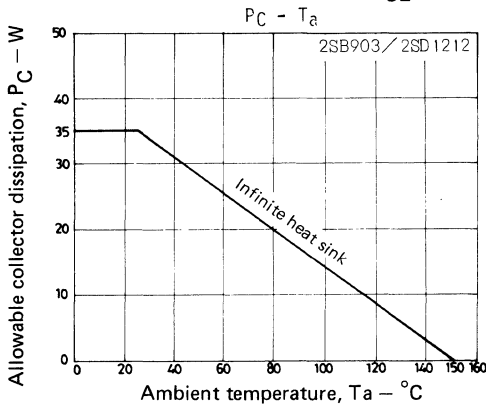
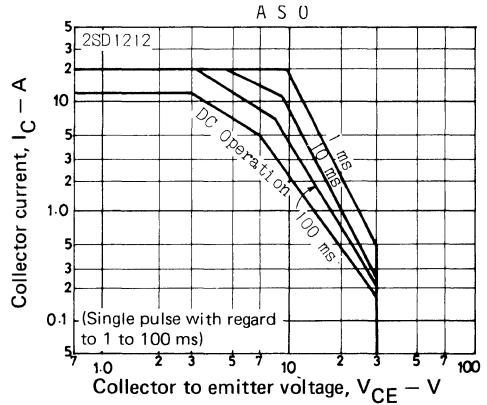
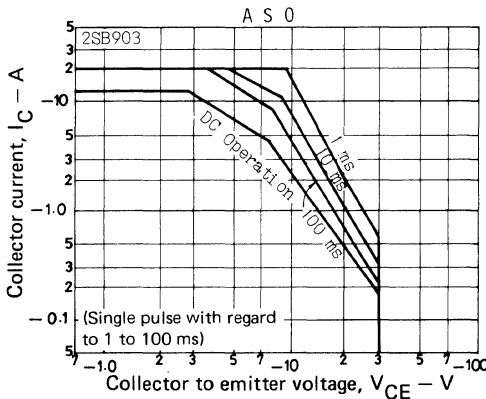
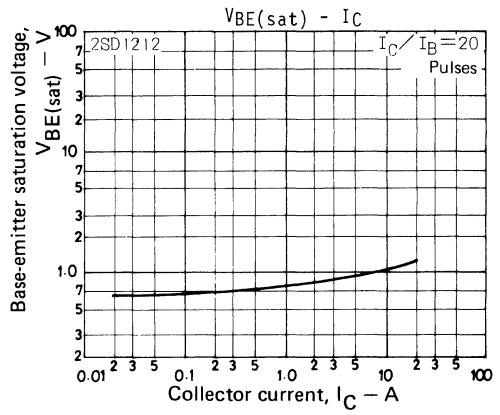
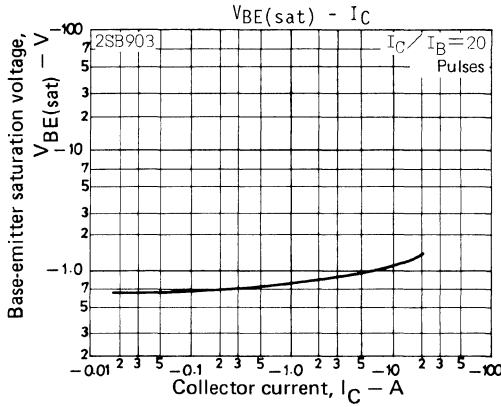
Switching time measurement circuit



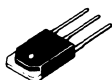
Case outline 2010A (unit: mm)







2SD1213



2022

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB904

High Current Switching Applications

©1022

Use

- Large current switching of relay drivers, high-speed inverters, converters

Features

- Low collector-to-emitter saturation voltage: $V_{CE(sat)} = -0.5V$ (PNP), $0.4V$ (NPN) max.
- Large current capacity

(): 2SB904

Absolute Maximum Ratings/ $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	(-) 60	V
Collector to Emitter Voltage	V_{CEO}	(-) 30	V
Emitter to Base Voltage	V_{EBO}	(-) 6	V
Collector Current	I_C	(-) 20	A
Peak Collector Current	i_{cp}	(-) 30	A
Collector Dissipation	P_C	$T_a = 25^\circ C$ $T_C = 25^\circ C$	2.5 60 W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to $+150$	$^\circ C$

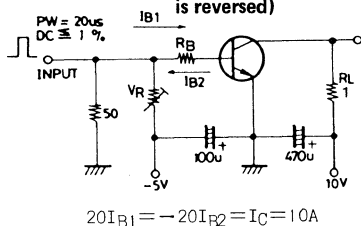
Electrical Characteristics/ $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-)40V, I_E = 0$			(-) 0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$			(-) 0.1	mA
Common emitter DC Current Gain	$h_{FE}(1)$	$V_{CE} = (-)2V, I_C = (-)1A$	70^*		280^*	
	$h_{FE}(2)$	$V_{CE} = (-)2V, I_C = (-)10A$	30			
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = (-)8A, I_B = (-)0.4A$		(-0.25)	(-0.5)	V
Gain Band-width Product	f_T	$V_{CE} = (-)5V, I_C = (-)1A$		120	0.2 0.4	MHz
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-)1mA, I_E = 0$	(-) 60			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-) 30			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-)1mA, I_C = 0$	(-) 6			V
Turn-on Time	t_{on}	at Specified Test Circuit		300		ns
Storage Time	t_{stg}	"		$(300)600$		ns
Fall Time	t_f	"		20		ns

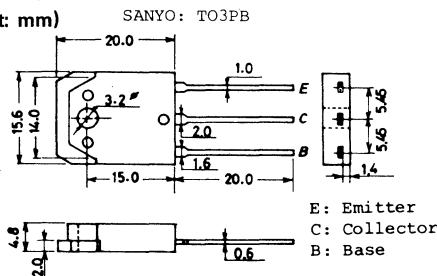
*The 2SB904/2SD1213 are classified as follows according to h_{FE} at 1A.

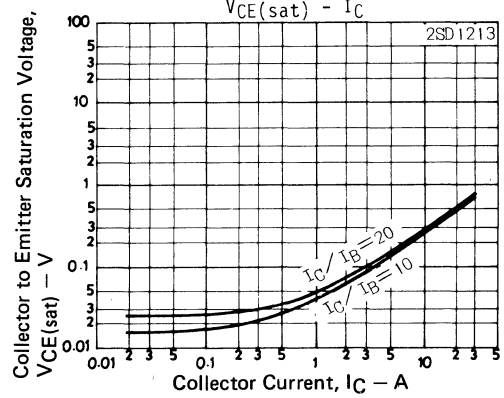
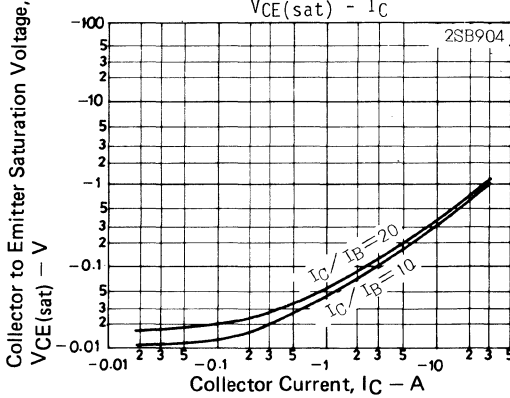
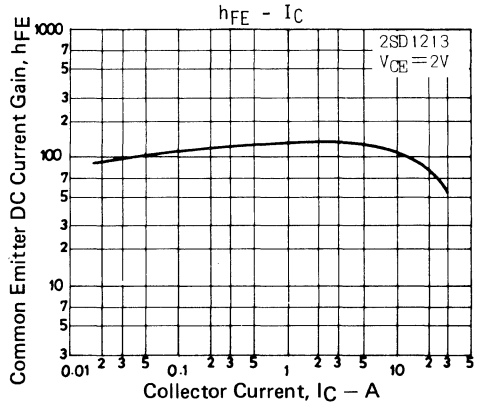
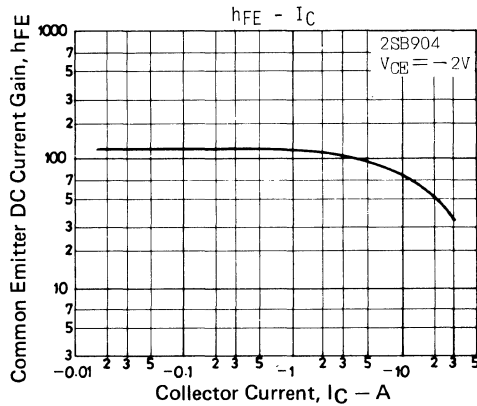
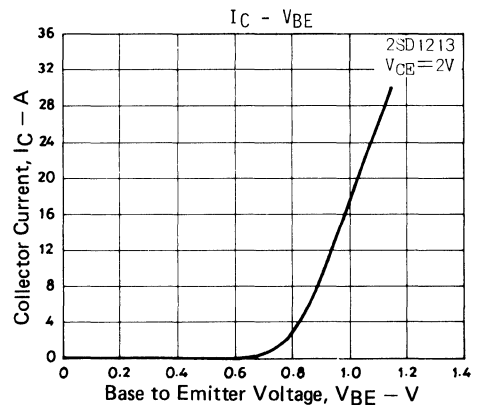
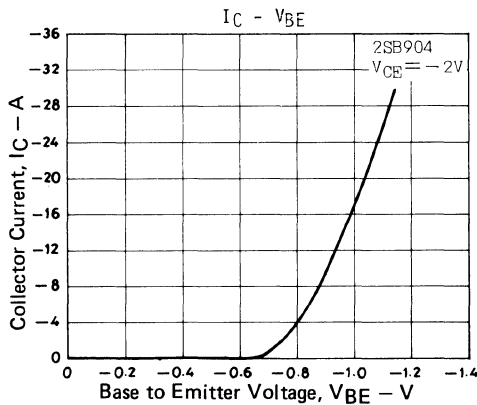
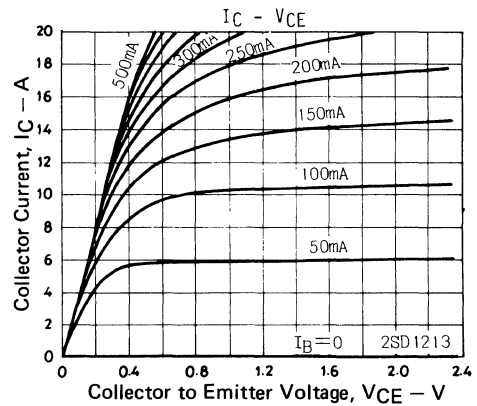
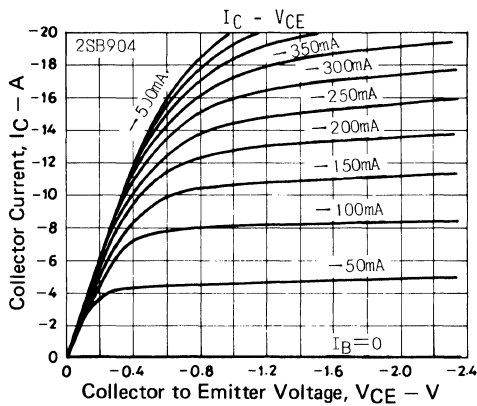
70	Q	140	100	R	200	140	S	280
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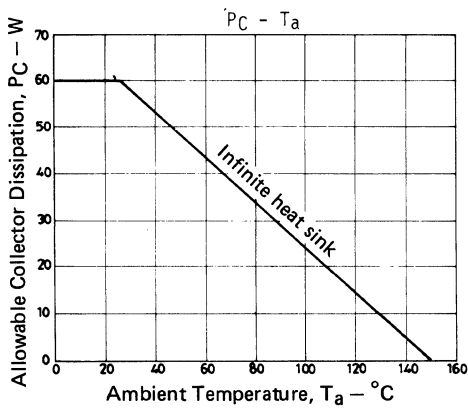
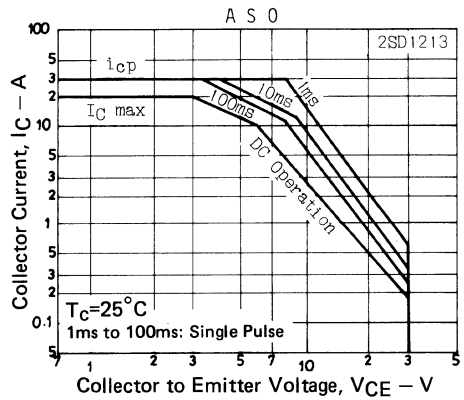
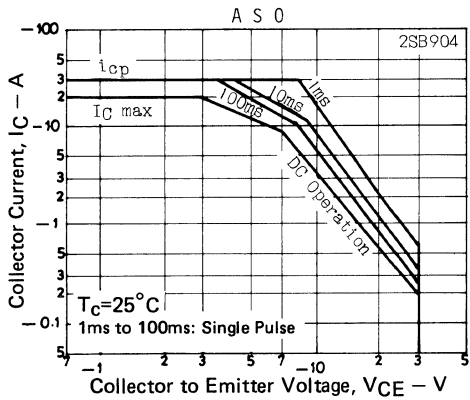
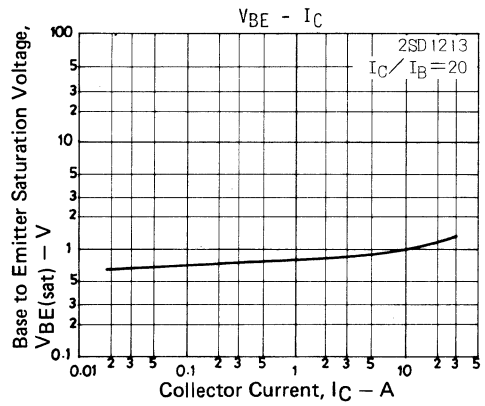
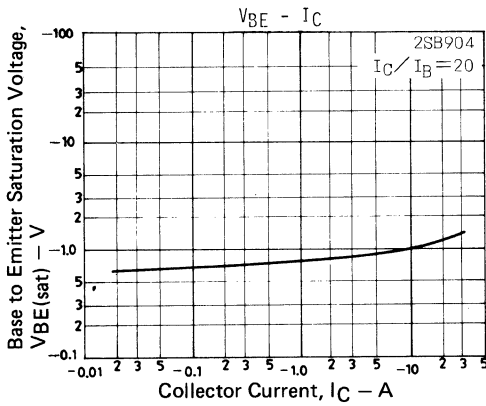
Switching Time Test Circuit (For PNP, the polarity is reversed)



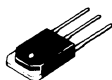
Case Outline 2022 (unit: mm)







2SD1229



2022

NPN/PNP Epitaxial Planar
Silicon Darlington Transistors**2SB912**

Driver Applications

©1028

Use : Motor drivers, printer hammer drivers, relay drivers, regulated DC power supply controllers.

- Features**
- a. High DC current gain
 - b. Large current capacity and wide ASO
 - c. Low saturation voltage

():2SB912

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

Absolute Maximum Ratings at Ta=25°C			unit	
Collector to Base Voltage	V _{CBO}	(-)70	V	
Collector to Emitter Voltage	V _{CEO}	(-)60	V	
Emitter to Base Voltage	V _{EBO}	(-)6	V	
Collector Current	I _C	(-)10	A	
Peak Collector Current	i _{cp}	(-)15	A	
Collector Dissipation	P _C	2.5	W	
		Tc=25°C	60	W
Junction Temperature	Tj	150	°C	
Storage Temperature	Tstg	-55 to +150	°C	

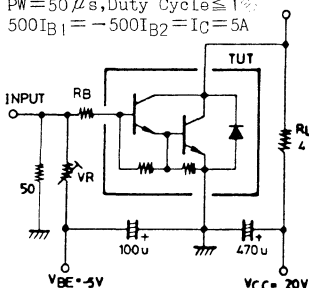
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{\text{CB}}=(-)40\text{V}, I_{\text{E}}=0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{\text{EB}}=(-)5\text{V}, I_{\text{C}}=0$			(-)3.0	mA
DC Current Gain	h_{FE}	$V_{\text{CE}}=(-)2\text{V}, I_{\text{C}}=(-)5\text{A}$	2000	5000		
Gain Band-width Product	f_{T}	$V_{\text{CE}}=(-)5\text{V}, I_{\text{C}}=(-)5\text{A}$		20		MHz
Collector to Emitter Saturation Voltage	$V_{\text{CE(sat)}}$	$I_{\text{C}}=(-)5\text{A}, I_{\text{B}}=(-)10\text{mA}$		0.9(-)1.5		V
				(-1.0)		
Base to Emitter Saturation Voltage	$V_{\text{BE(sat)}}$	$I_{\text{C}}=(-)5\text{A}, I_{\text{B}}=(-)10\text{mA}$		(-)2.0		V
Collector to Base Breakdown Voltage	$V_{(\text{BR})\text{CBO}}$	$I_{\text{C}}=(-)5\text{mA}, I_{\text{E}}=0$	(-)70			V
Collector to Emitter Breakdown Voltage	$V_{(\text{BR})\text{CEO}}$	$I_{\text{C}}=(-)50\text{mA}, R_{\text{BE}}=\infty$	(-)60			V
Turn-on Time	t_{on}	at Specified Test Circuit	(0.5)0.6			us
Storage Time	t_{stg}	"	(1.5)3.0			us
Fall Time	t_{f}	"	(1.7)1.8			us

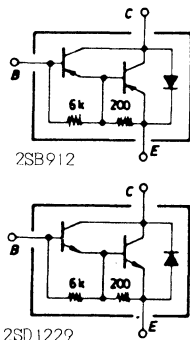
Specified Test Circuit

(For PNP, the polarity is reversed.)

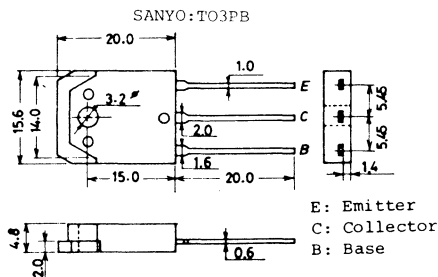
$PW=50\mu\text{s}$, Duty Cycle $\leq 1\%$
 $500I_{\text{B1}}=-500I_{\text{B2}}=I_{\text{C}}=5\text{A}$

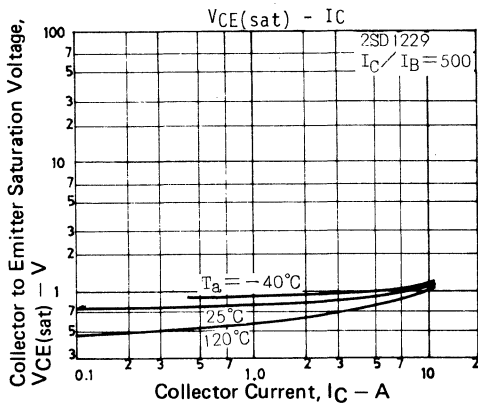
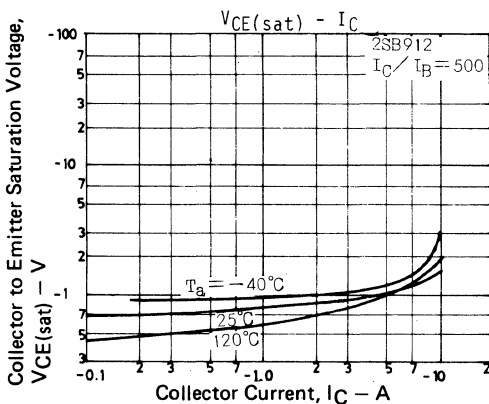
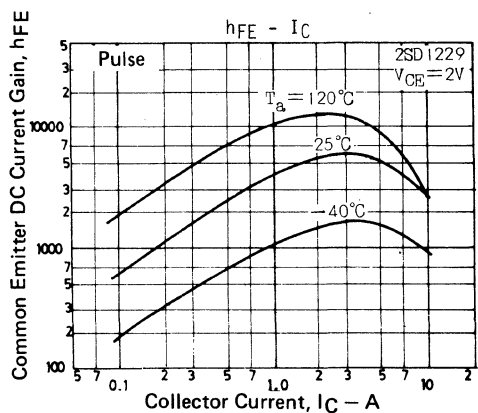
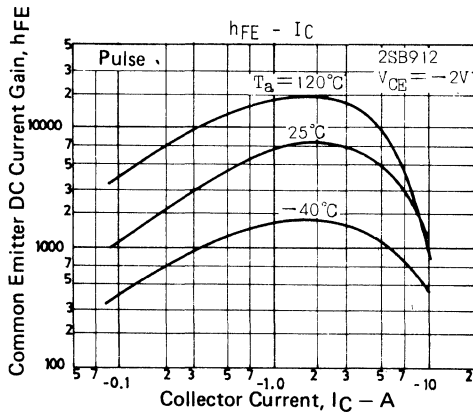
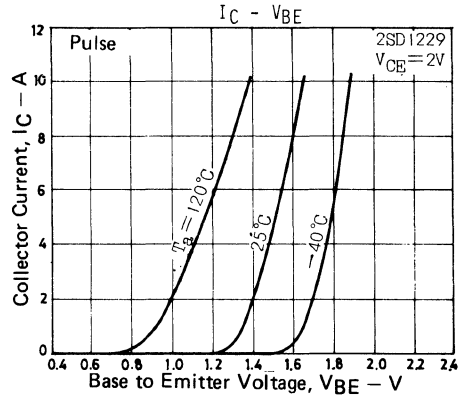
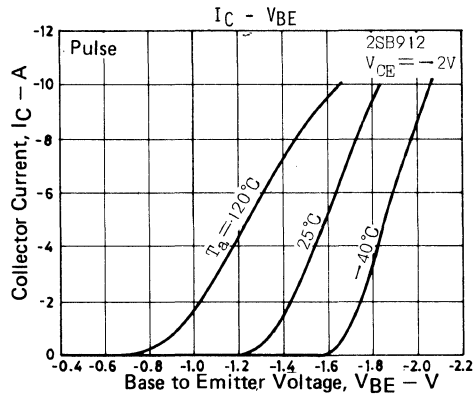
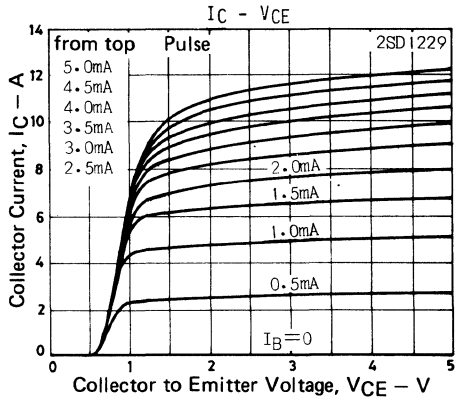
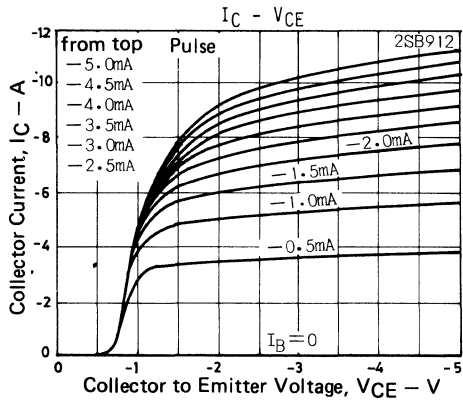


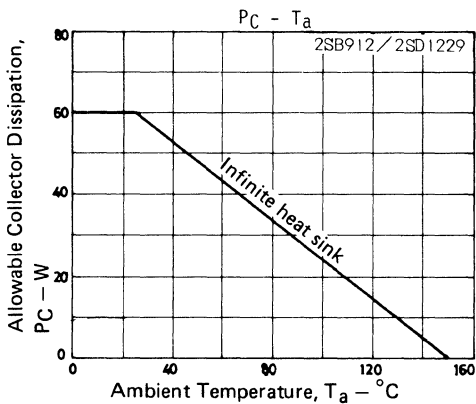
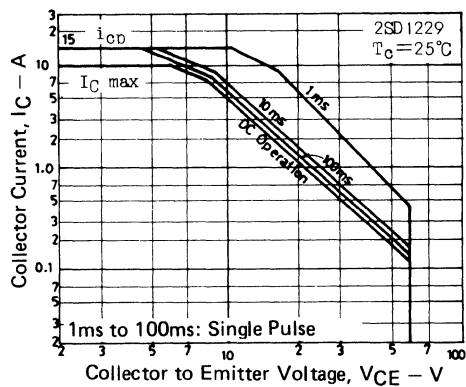
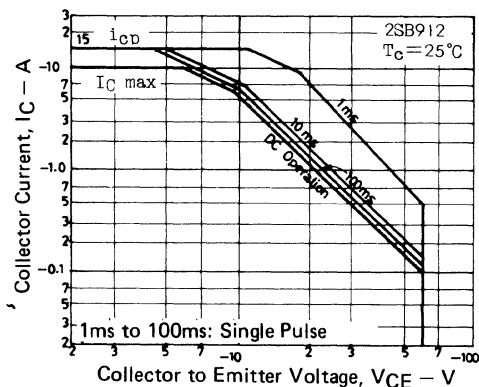
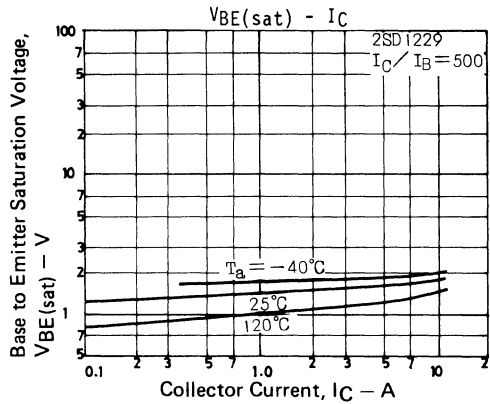
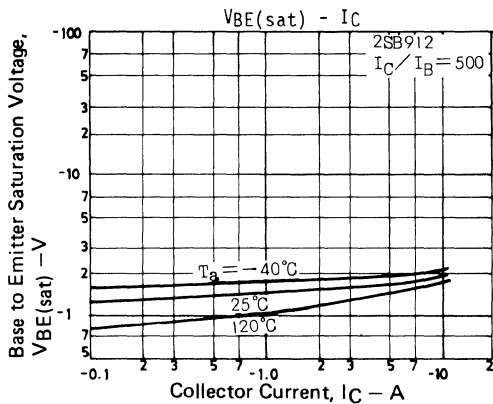
Equivalent Circuit



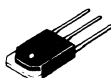
Case Outline 2022 (unit:mm)







2SD1230



2022

NPN/PNP Epitaxial Planar
Silicon Darlington Transistors

2SB913

Driver Applications

©1034

Use : Motor drivers, printer hammer drivers, relay drivers, regulated DC power supply controllers.

Features : a. High DC current gain
b. Large current capacity and wide ASO
c. Low saturation voltage

() : 2SB913

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

Absolute Maximum Ratings at Ta=25°C			unit	
Collector to Base Voltage	V _{CB0}	(-)110	V	
Collector to Emitter Voltage	V _{CE0}	(-)100	V	
Emitter to Base Voltage	V _{EB0}	(-)6	V	
Collector Current	I _C	(-)8	A	
Peak Collector Current	i _{cp}	(-)12	A	
Collector Dissipation	P _C	2.5	W	
		Tc=25°C	60	W
Junction Temperature	T _j	150	°C	
Storage Temperature	T _{stg}	-55 to +150	°C	

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

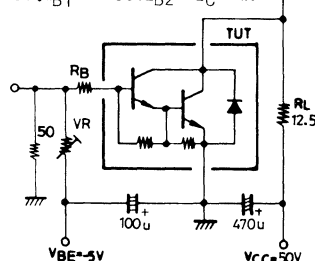
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)80\text{V}, I_E=0$		(-)0.1		mA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)5\text{V}, I_C=0$		(-)3		mA
DC Current Gain	h_{FE}	$V_{CE}=(-)3\text{V}, I_C=(-)4\text{A}$	1500	4000		
Gain Band-width Product	f_T	$V_{CE}=(-)5\text{V}, I_C=(-)4\text{A}$		20		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)4\text{A}, I_B=(-)8\text{mA}$		0.9(-)1.5		V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)4\text{A}, I_B=(-)8\text{mA}$		(-)2.0		V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5\text{mA}, I_E=0$	(-)110			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=50\text{mA}, R_{BE}=\infty$	(-)100			V
Turn-on Time	t_{on}	at Specified Test Circuit	(0.7)0.6			us
Storage Time	t_{stg}	"	(1.4)4.8			us
Fall Time	t_f	"	(1.5)1.6			us

Specified Test Circuit

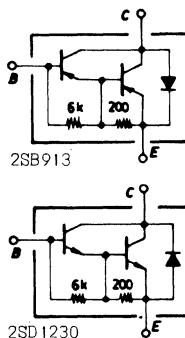
(For NPN, the polarity is reversed.)

$PW=50\mu\text{s}, \text{Duty Cycle} \leq 1\%$

$500I_{B1} = -500I_{B2} = I_C = 4\text{A}$

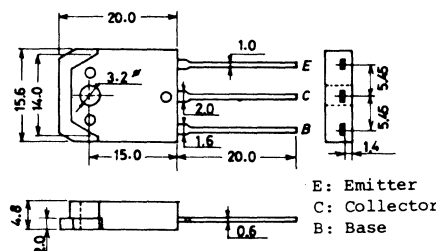


Equivalent Circuit

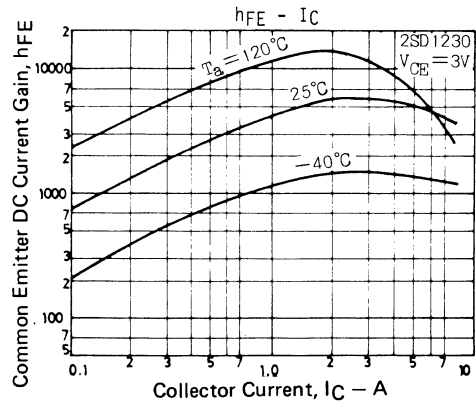
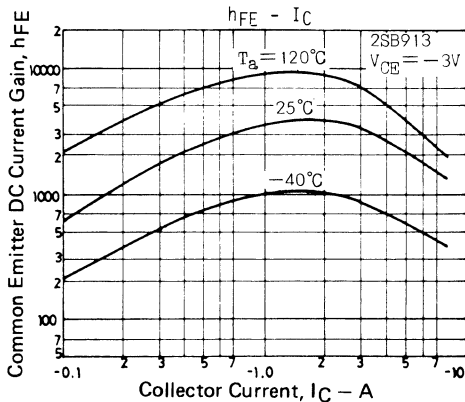
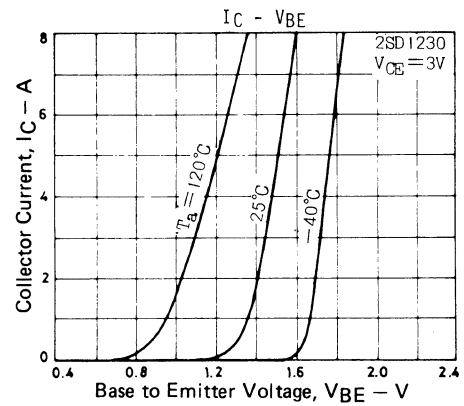
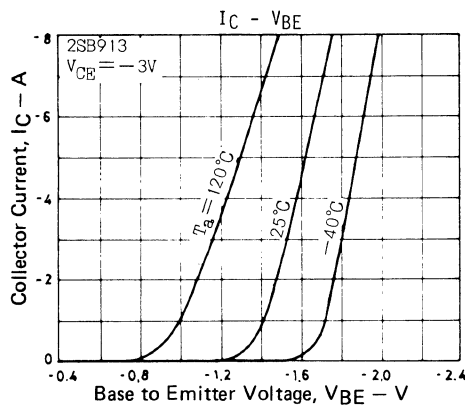
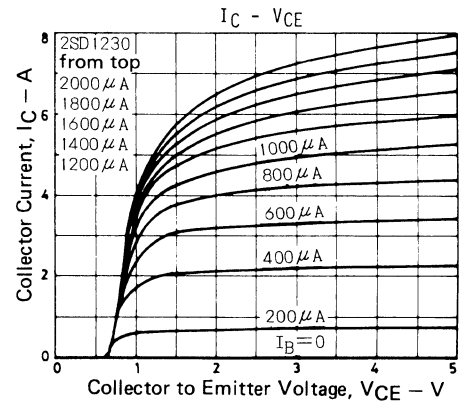
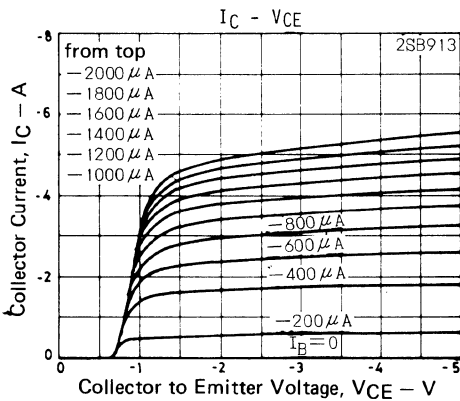
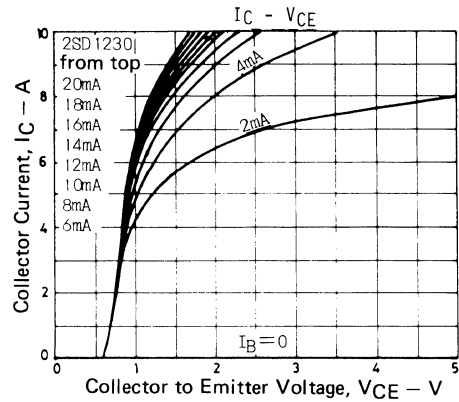
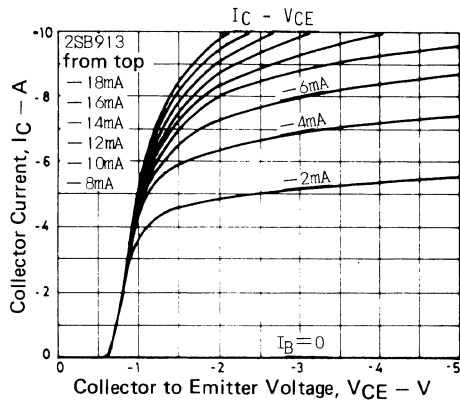


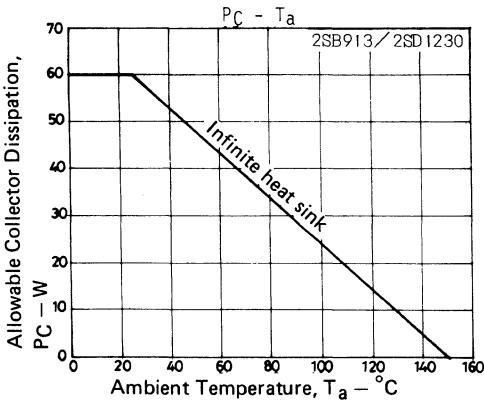
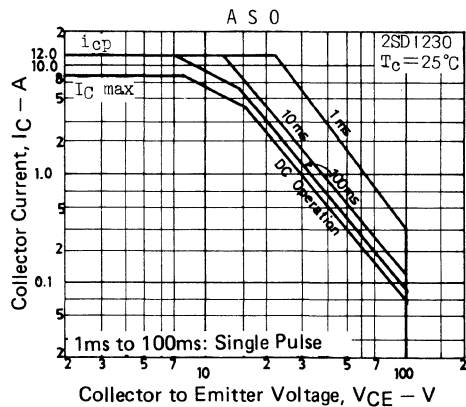
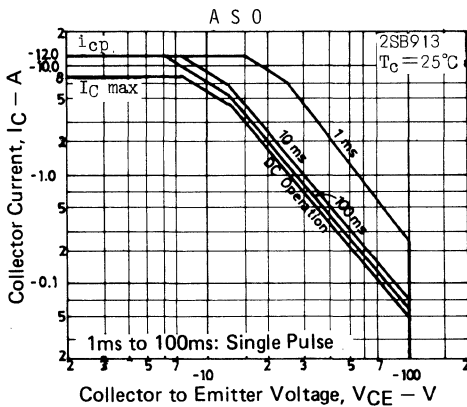
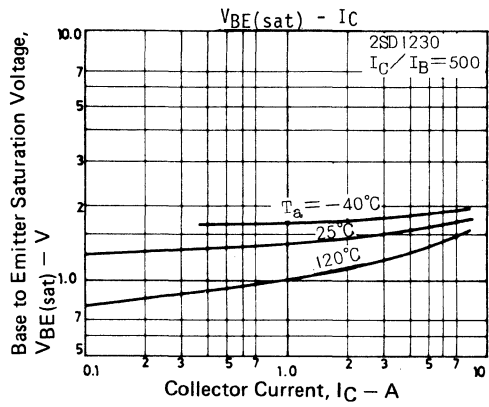
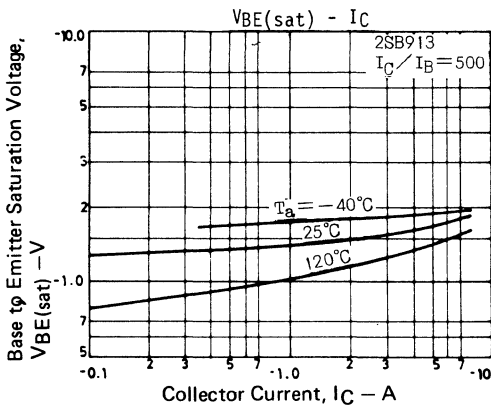
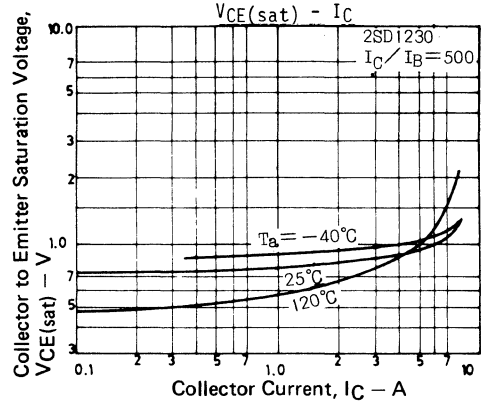
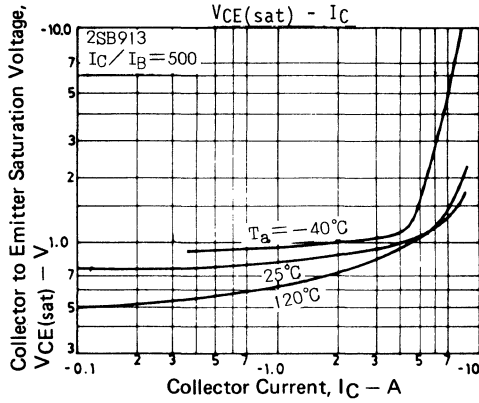
Case Outline 2022
(unit:mm)

SANYO: TO3PB

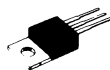


0193KI, TS No.1034-1/3





2SD1235



2010A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB919

High Current Switching Applications

(E)1046

Use

- Large current switching of relay drivers, high-speed inverters, converters

Features

- Low collector-to-emitter saturation voltage: $V_{CE(sat)} = -0.5V$ (PNP), $0.4V$ (NPN) max.
- Large current capacity

() : 2SB919

Absolute Maximum Ratings/ $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	(-)60	V
Collector to Emitter Voltage	V_{CEO}	(-)30	V
Emitter to Base Voltage	V_{EBO}	(-)6	V
Collector Current	I_C	(-)8	A
Peak Collector Current	i_{cp}	(-)15	A
Collector Dissipation	P_C	$T_a = 25^\circ C$ 1.75 $T_c = 25^\circ C$ 30	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

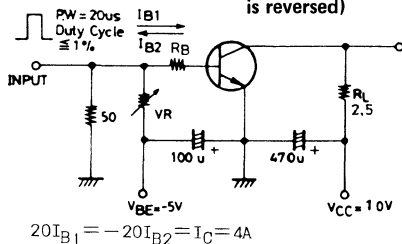
Electrical Characteristics/ $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-)40V, I_E = 0$			(-)0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$			(-)0.1	mA
Common Emitter DC Current Gain	$h_{FE}(1)$	$V_{CE} = (-)2V, I_C = (-)1A$	70*		280*	
	$h_{FE}(2)$	$V_{CE} = (-)2V, I_C = (-)4A$	30			
Gain Band-width Product	f_T	$V_{CE} = (-)5V, I_C = (-)1A$		120		MHz
Collector to Emitter Saturation	$V_{CE(sat)}$	$I_C = (-)3A, I_B = (-)0.15A$			0.4 (-0.5)	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-)1mA, I_E = 0$	(-)60			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-)30			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-)1mA, I_C = 0$	(-)6			V
Turn-on Time	t_{on}	at Specified Test Circuit		0.1		μs
Storage Time	t_{stg}	"		(0.2)0.5		μs
Fall Time	t_f	"		0.03		μs

* The 2SB919/2SD1235 are classified as follows according to h_{FE} at 1A.

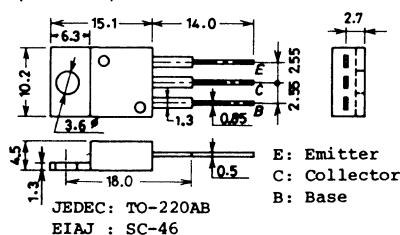
70	Q	140	100	R	200	140	S	280
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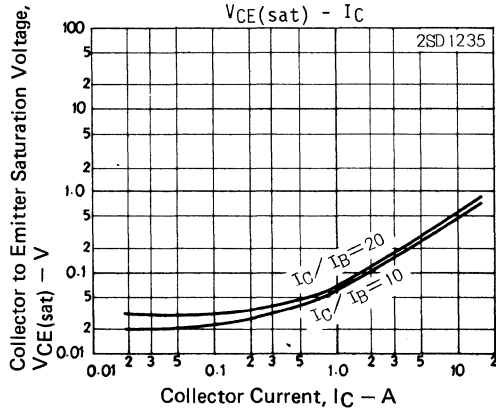
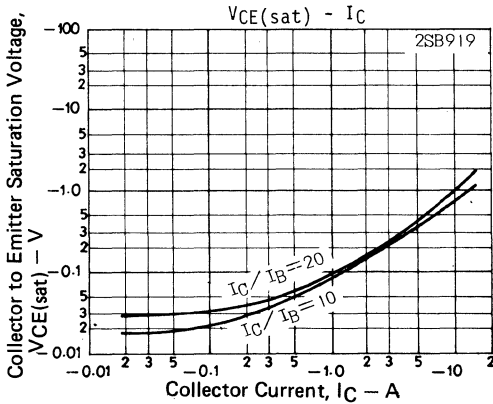
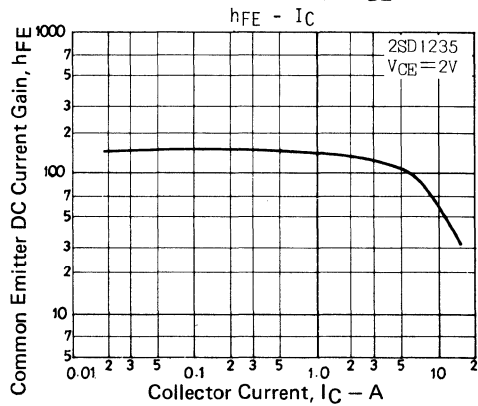
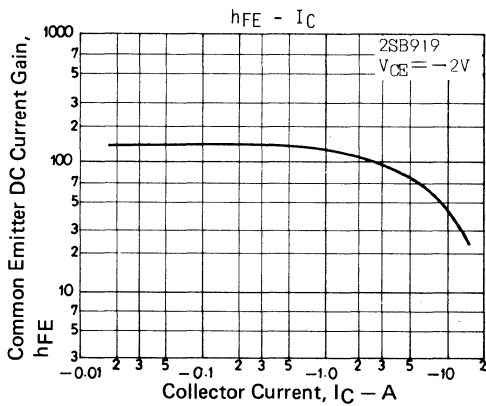
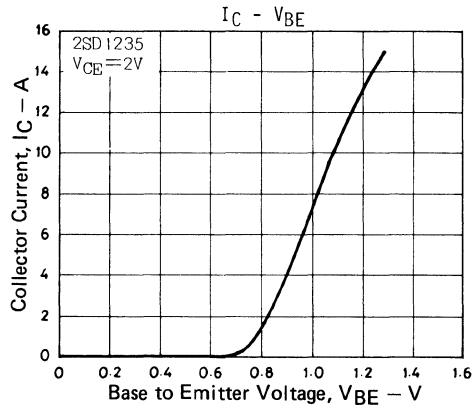
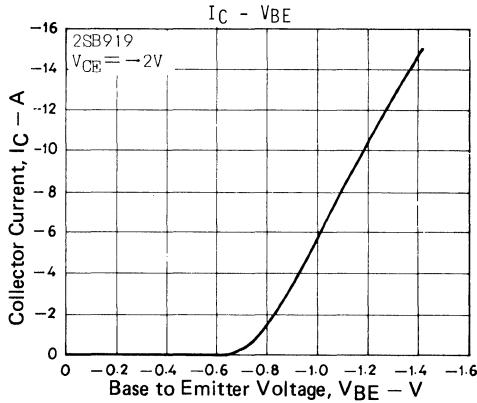
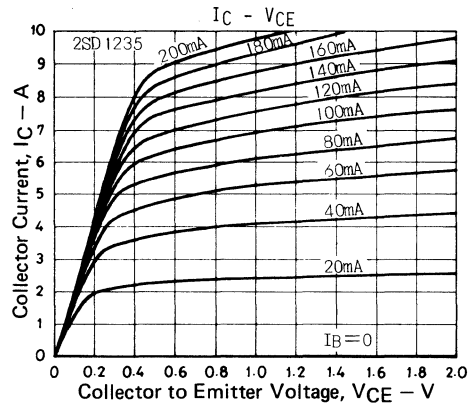
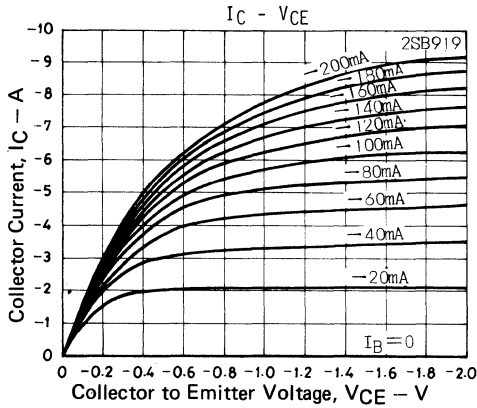
Switching Time Test Circuit (For PNP, the polarity is reversed)

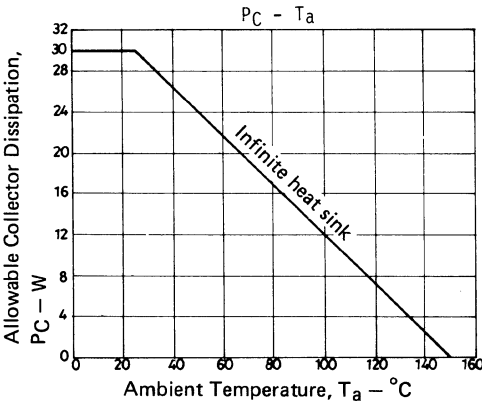
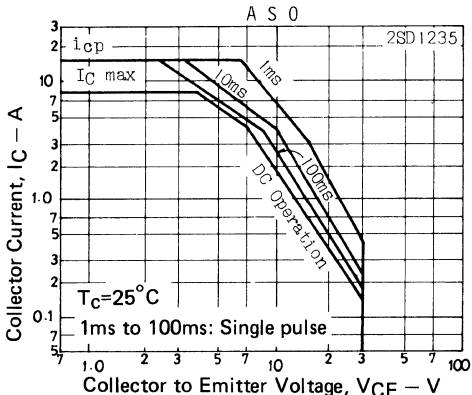
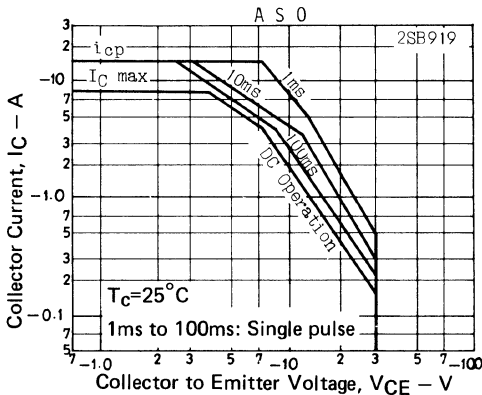
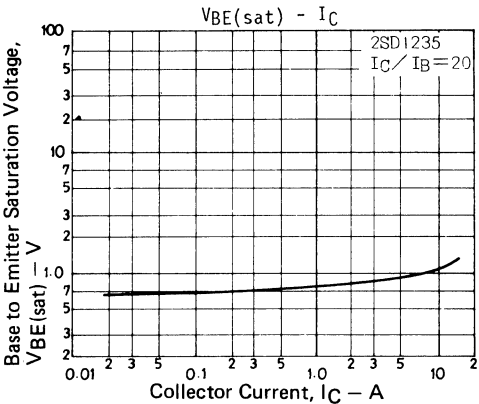
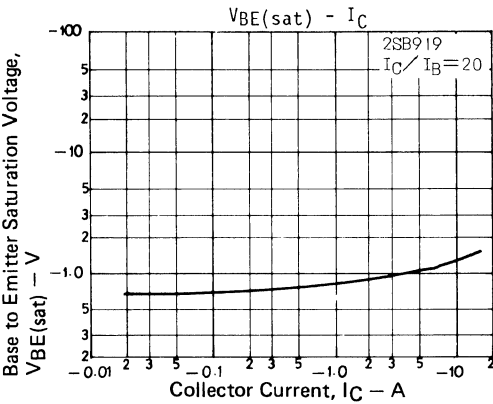


Case Outline 2010A

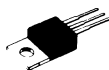
(unit: mm)







2SD1236L



2010A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB920L

High Current Switching Applications

©1796

Applications

- Suitable for relay drivers, high-speed inverters, converters and other general high-current switching applications.

Features

- Low collector-emitter saturation voltage: $V_{CE(sat)} = (-)0.5V(\text{PNP}), 0.4V(\text{NPN})\text{max.}$
- Large current capacity.

(): 2SB920L

Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$

Absolute Maximum Ratings at Ta=25°C			unit
Collector to Base Voltage	V _{CBO}	(-)90	V
Collector to Emitter Voltage	V _{CEO}	(-)80	V
Emitter to Base Voltage	V _{EBO}	(-)6	V
Collector Current	I _C	(-)5	A
Peak Collector Current	i _{cp}	(-)9	A
Collector Dissipation	P _C	1.75	W
		Tc=25°C	30
Junction Temperature	Tj	150	°C
Storage Temperature	Tstg	-55 to +150	°C

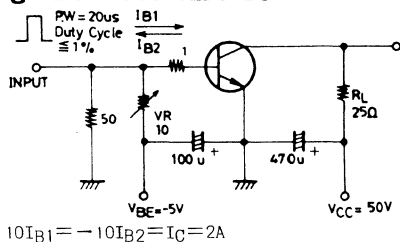
Electrical Characteristics at $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-)80V, I_E = 0$		(-)0.1		mA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-)4V, I_C = 0$		(-)0.1		mA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE} = (-)2V, I_C = (-)1A$	70*		280*	
	$h_{FE}(2)$	$V_{CE} = (-)2V, I_C = (-)3A$	30			
Gain Bandwidth Product	f_T	$V_{CE} = (-)5V, I_C = (-)1A$		20		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-)3A, I_B = (-)0.3A$			0.4 (-0.5)	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-)1mA, I_E = 0$	(-)90			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-)80			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-)1mA, I_C = 0$	(-)6			V
Turn-ON Time	t_{on}	At specified Test Circuit		(0.2)0.1		us
Storage Time	t_{stg}	"		(0.7)1.2		us
Fall Time	t_f	"		(0.2)0.4		us

* The 2SB920L/2SD1236L are graded as follows by h_{FE} at 1A.

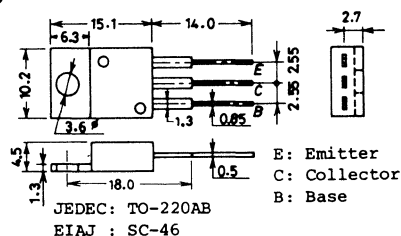
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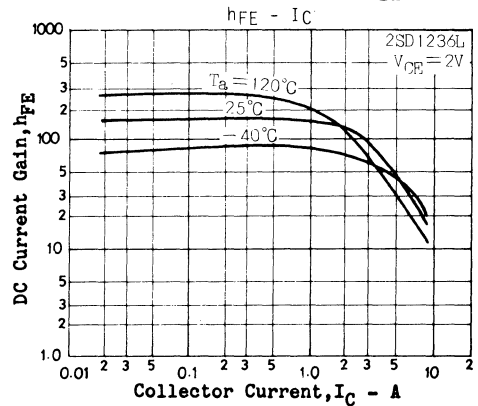
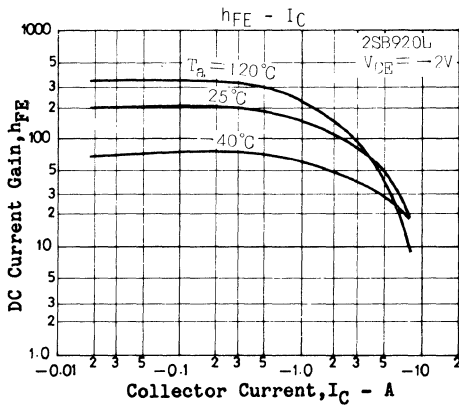
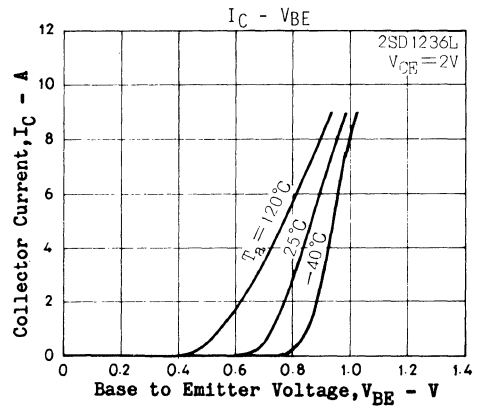
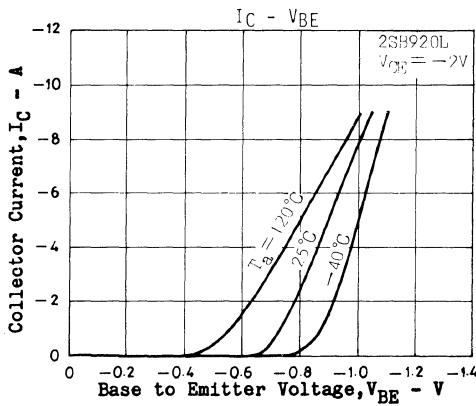
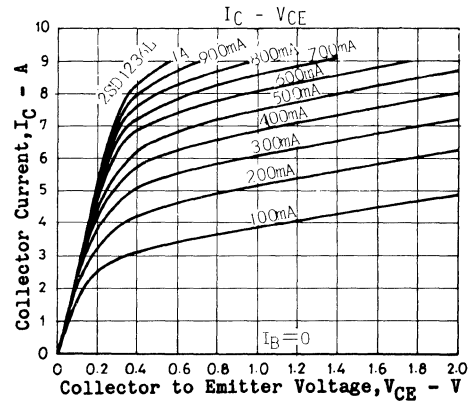
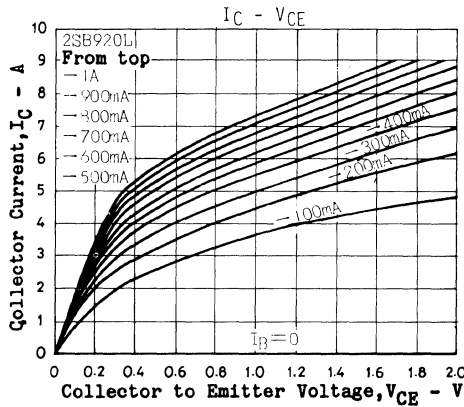
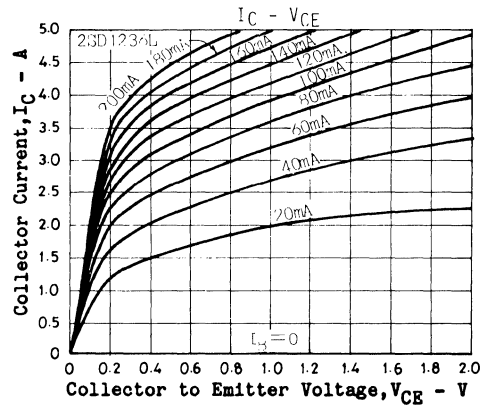
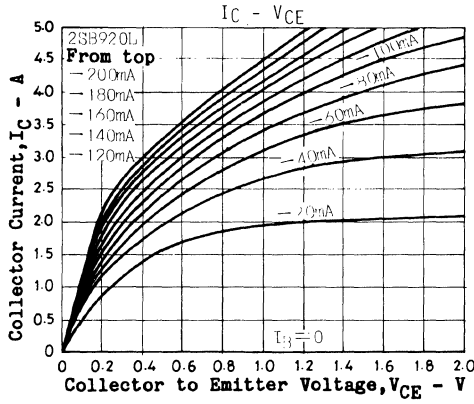
Switching Time Test Circuit

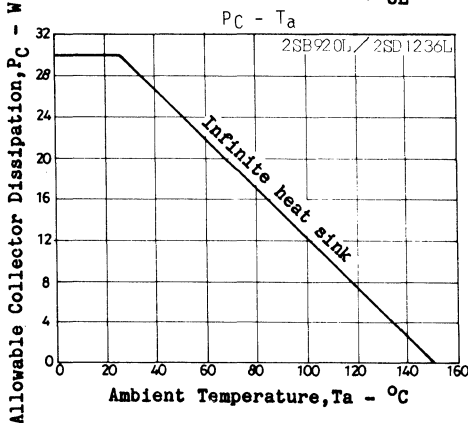
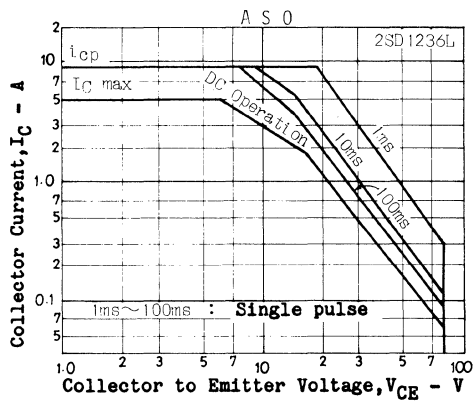
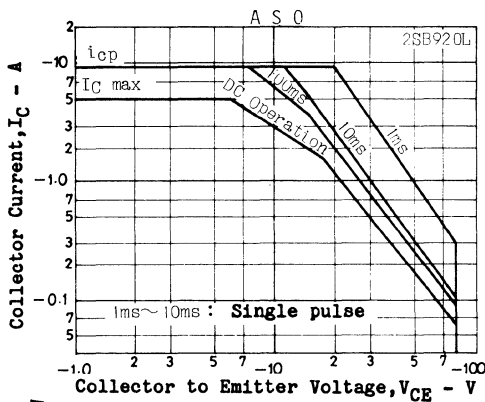
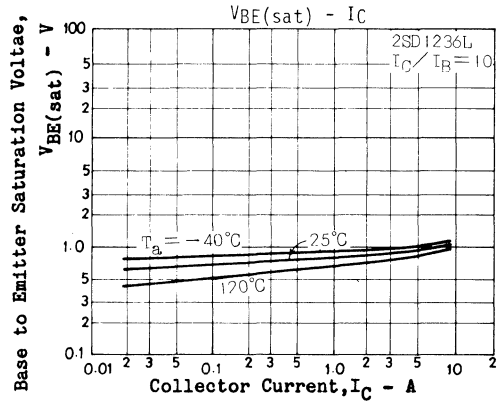
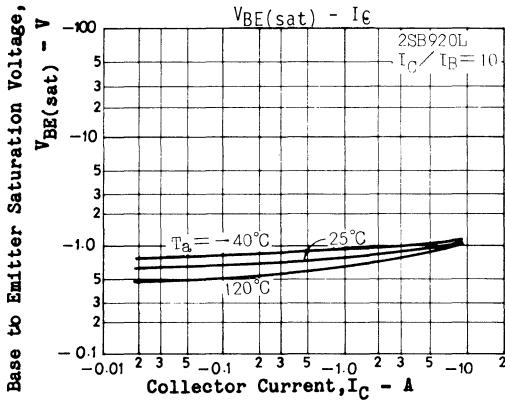
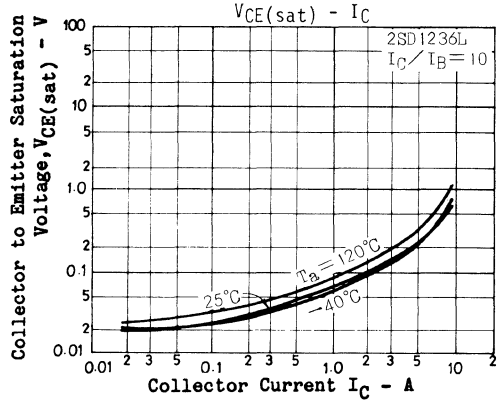
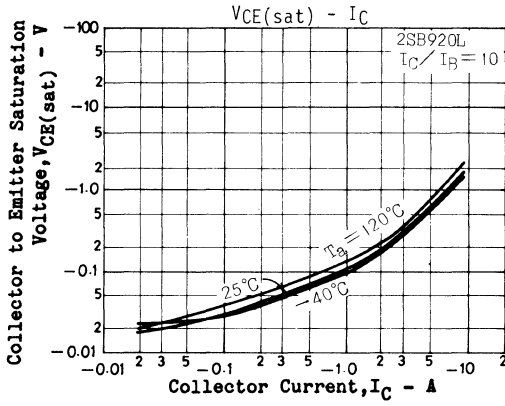


Case Outline 2010A

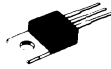
(unit:mm)







2SD1237L



2010A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB921L

High Current Switching Applications

(E)1797

APPLICATIONS

- Suitable for relay drivers, high-speed inverters, converters, and other general large-current switching applications

FEATURES

- Low collector-emitter saturation voltage: $V_{CE(sat)} = -0.5V(\text{PNP}), 0.4V(\text{NPN})$ max.
- Large current capacity

Values for 2SB921 shown in ()

ABSOLUTE MAXIMUM RATINGS/ $T_a=25^\circ\text{C}$

ABSOLUTE MAXIMUM RATINGS/T _a =25°C			unit	
Collector to base voltage	V _{CBO}	(-)90	V	
Collector to emitter voltage	V _{CEO}	(-)80	V	
Emitter to base voltage	V _{EBO}	(-)6	V	
Collector current	I _C	(-)7	A	
Peak collector current	i _{cp}	(-)12	A	
Allowable collector dissipation	P _C	1.75	W	
		T _c =25°C	40	W
Junction temperature	T _j	150	°C	
Storage ambient temperature	T _{stg}	-55~+150	°C	

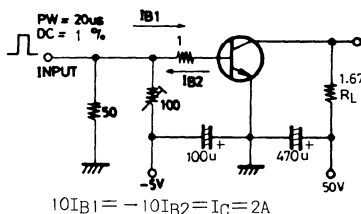
ELECTRICAL CHARACTERISTICS/ $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector cut-off current	I_{CBO}	$V_{CB}=(-)80V, I_E=0$			(-)0.1	mA
Emitter cut-off current	I_{EBO}	$V_{EB}=(-)4V, I_C=0$			(-)0.1	mA
DC current gain	$h_{FE}(1)^*$	$V_{CE}=(-)2V, I_C=(-)1A$	70*		280*	
	$h_{FE}(2)$	$V_{CE}=(-)2V, I_C=(-)4A$	30			
Gain bandwidth product	f_T	$V_{CE}=(-)5V, I_C=(-)1A$		20		MHz
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C=(-)4A, I_B=(-)0.4A$			0.4	V
					(-0.5)	V
Collector-base breakdown voltage	$V_{(BR)CBO}$	$I_C=(-)1mA, I_E=0$	(-)90			V
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	(-)80			V
Emitter-base breakdown voltage	$V_{(BR)EBO}$	$I_E=(-)1mA, I_C=0$	(-)6			V
Turn-on time	t_{on}	at the appointed circuit		(0.2)0.1		μs
Storage time	t_{stg}	at the appointed circuit		(0.7)1.6		μs
Fall time	t_f	at the appointed circuit		(0.2)0.4		μs

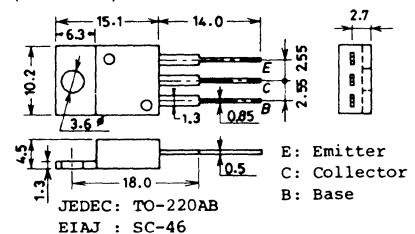
* 2SB921 and 2SD1237 are graded as follows by h_{FE} at 1A:

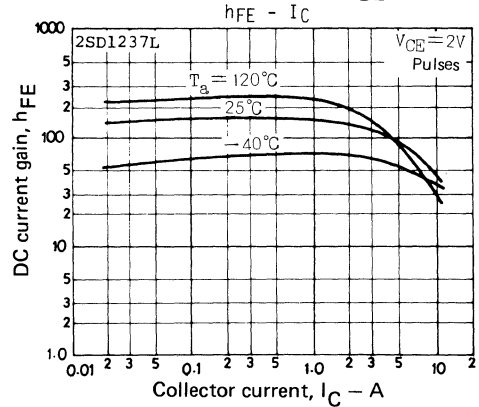
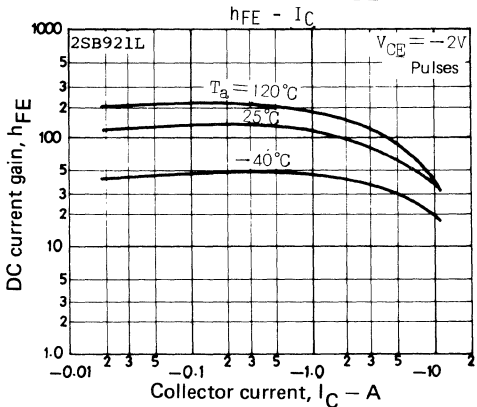
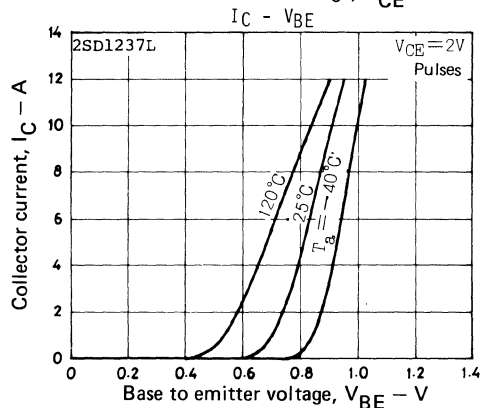
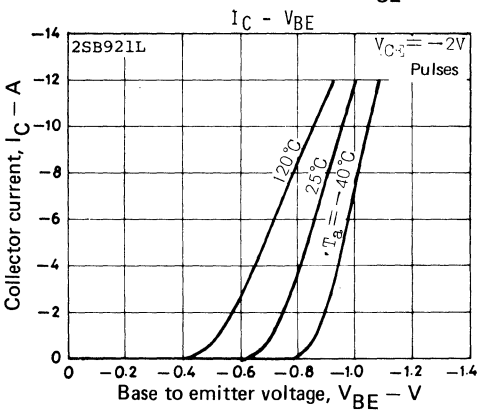
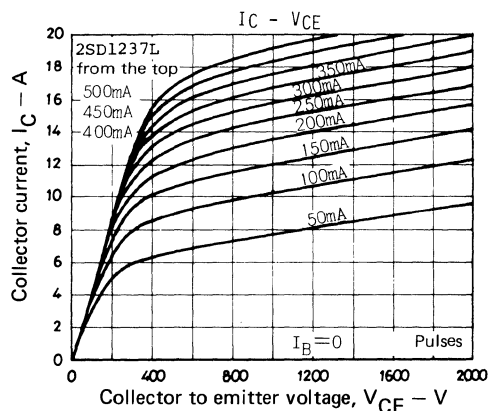
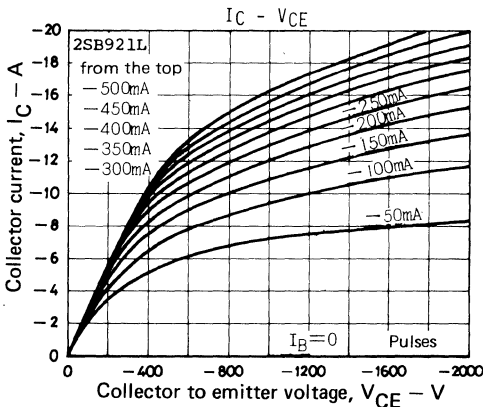
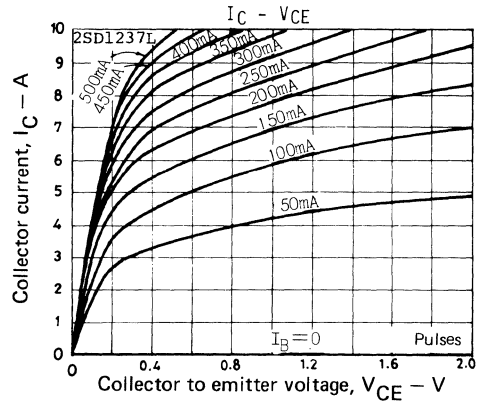
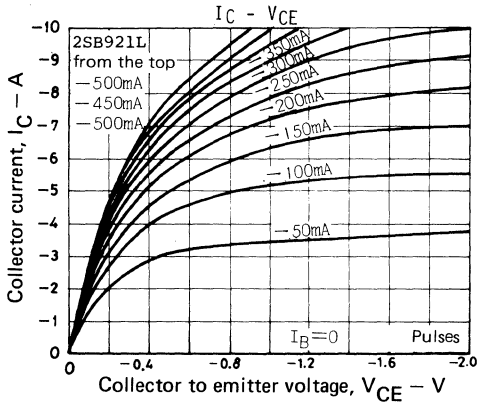
70	Q	140	100	R	200	140	S	280
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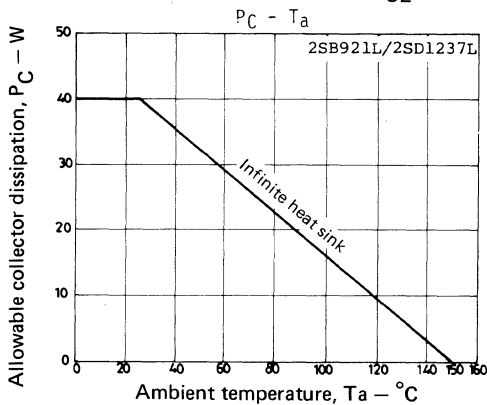
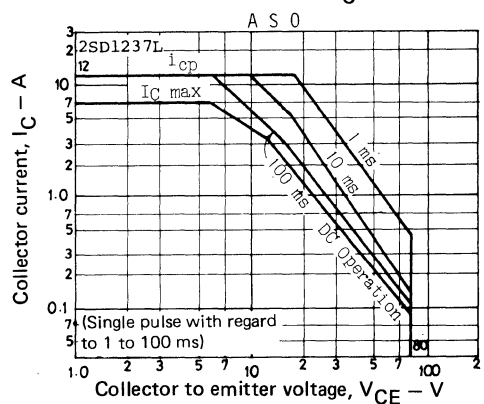
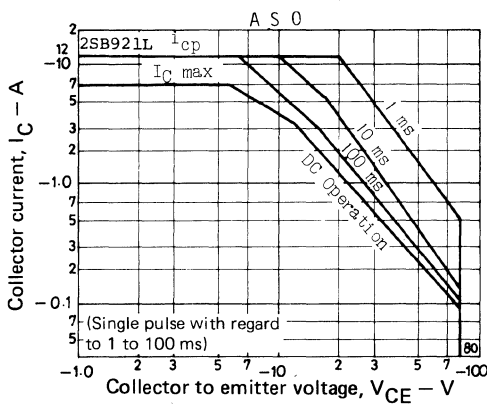
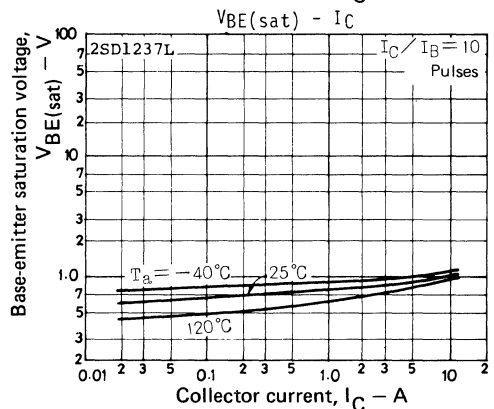
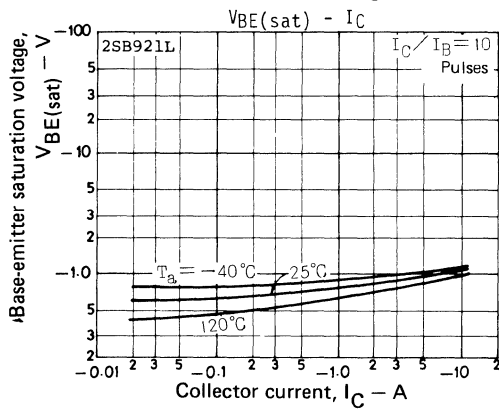
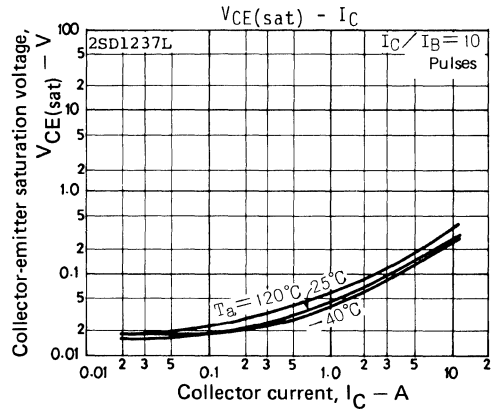
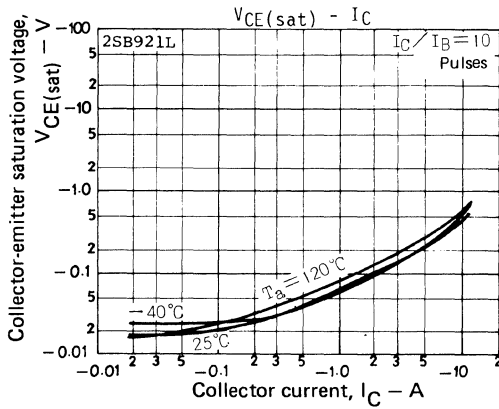
Switching time measurement circuit



Case outline 2010A
(unit: mm)







2SD1238L



2022

NPN/PNP Epitaxial Planar
Silicon Transistors**2SB922L**

High Current Switching Applications

©1798

Use

Suitable for relay drivers, high-speed inverters, converters, and other large-current switching applications.

Features

- Low collector-to-emitter saturation voltage: $V_{CE(sat)} = -0.5V$ (PNP), $0.4V$ (NPN) max.
 - Wide ASO and highly resistant to breakdown
- (): 2SB922L

Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	(-) 90	V
Collector to Emitter Voltage	V_{CEO}	(-) 80	V
Emitter to Base Voltage	V_{EBO}	(-) 6	V
Collector Current	I_C	(-) 12	A
Peak Collector Current	i_{cp}	(-) 20	A
Collector Dissipation	P_C	$T_c = 25^\circ C$	80 W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

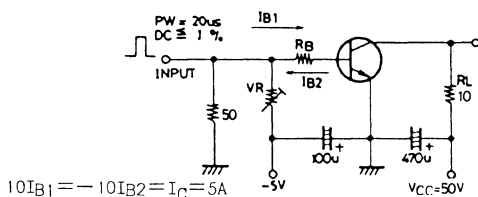
Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = (-) 80V, I_E = 0$			(-) 0.1	mA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = (-) 4V, I_C = 0$			(-) 0.1	mA
DC Current gain	$h_{FE}(1)$	$V_{CE} = (-) 2V, I_C = (-) 1A$	70*		280*	
	$h_{FE}(2)$	$V_{CE} = (-) 2V, I_C = (-) 6A$	30			
Gain Bandwidth Product	f_T	$V_{CE} = (-) 5V, I_C = (-) 1A$		20		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = (-) 6A, I_B = (-) 0.6A$			0.4 (-0.5)	V
C-B Breakdown Voltage	$V(BR)_{CBO}$	$I_C = (-) 1mA, I_E = 0$	(-) 90			V
C-E Breakdown Voltage	$V(BR)_{CEO}$	$I_C = (-) 1mA, R_{BE} = \infty$	(-) 80			V
E-B Breakdown Voltage	$V(BR)_{EBO}$	$I_E = (-) 1mA, I_C = 0$	(-) 6			V
Turn-on Time	t_{on}	at test circuit		0.2		us
Storage Time	t_{stg}	"		1.7 (0.7)		us
Fall Time	t_f	"		0.2 (0.1)		us

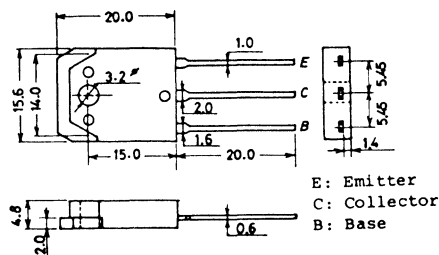
*: The 2SB922L/2SD1238L are classified by 1A h_{FE} as follows:

70	Q	140	100	R	200	140	S	280
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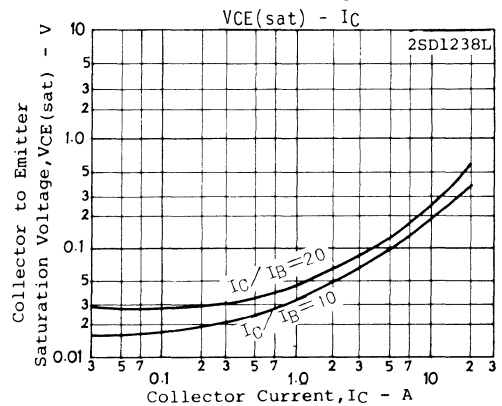
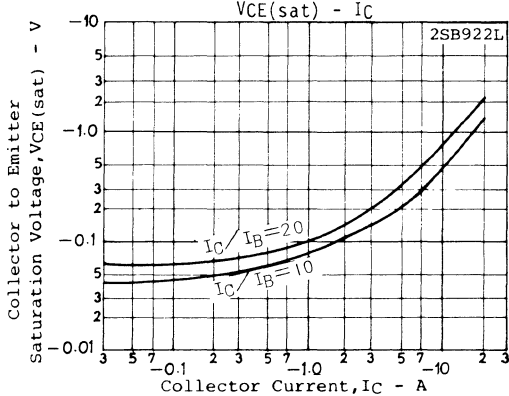
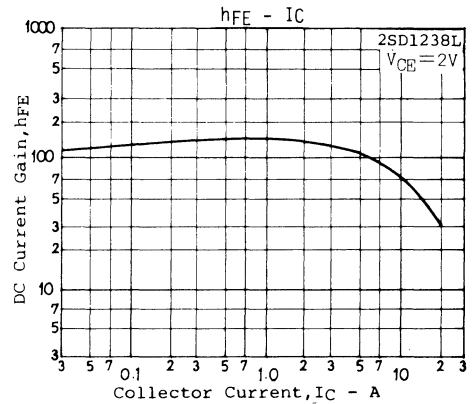
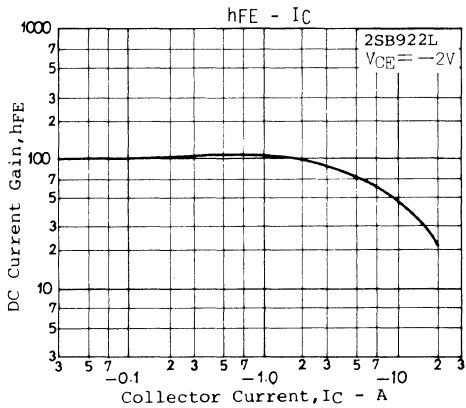
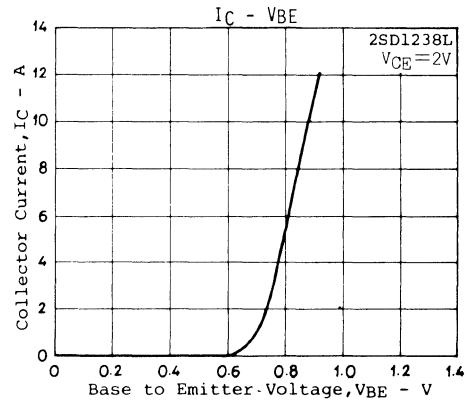
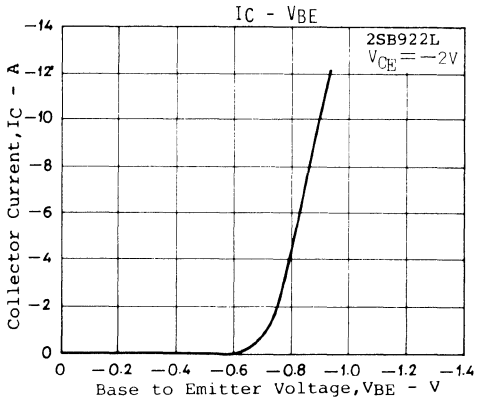
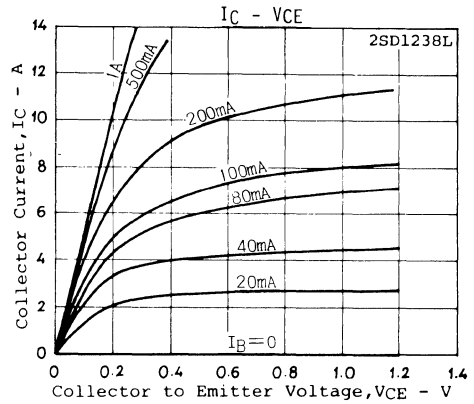
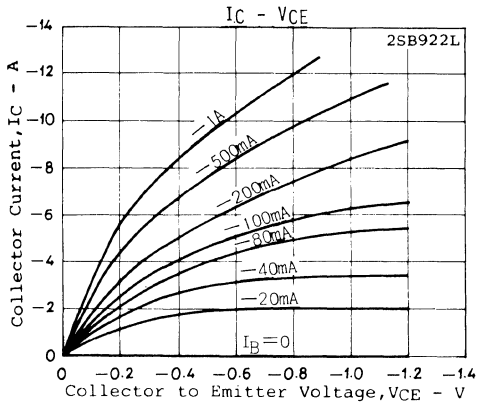
Switching Time Test Circuit

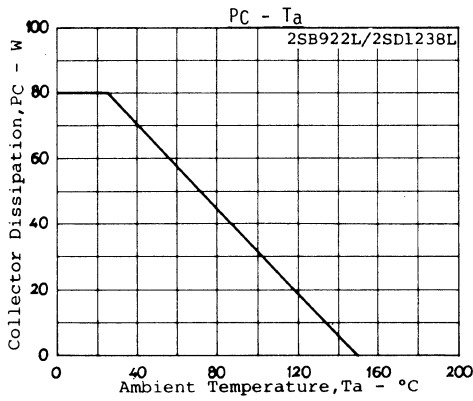
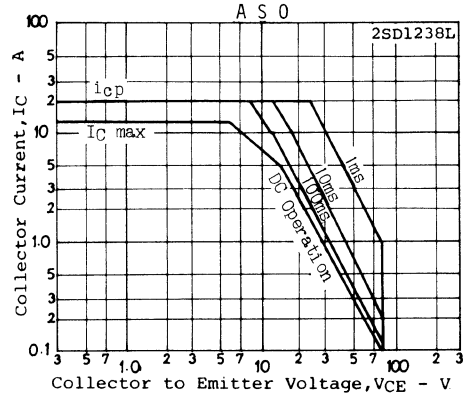
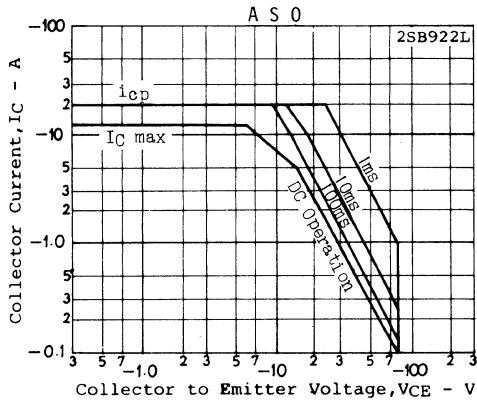


Case Outline 2022 (unit:mm)



2275MY/1114KI, MT No.1798-1/3





2SD1246



2003A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB926

High Current Switching Applications

Ⓔ1030D

Applications

- Power supplies, relay drivers, car applications

Features

- Adoption of FBET, MBIT process
- Low saturation voltage
- Large current capacity and wide ASO

() : 2SB926

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Collector to base voltage	V_{CBO}	(-) 30	V
Collector to emitter voltage	V_{CEO}	(-) 25	V
Emitter to base voltage	V_{EBO}	(-) 6	V
Collector current	I_C	(-) 2	A
Peak collector current	i_{cp}	(-) 5	A
Collector dissipation	P_C	0.75	W
Junction temperature	T_j	150	$^\circ\text{C}$
Storage temperature	T_{stg}	$-55 \sim +150$	$^\circ\text{C}$

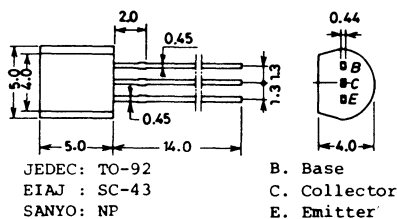
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

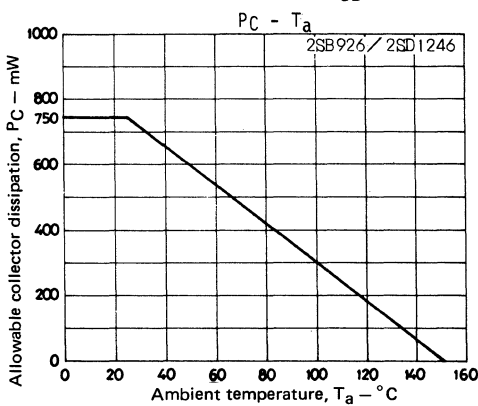
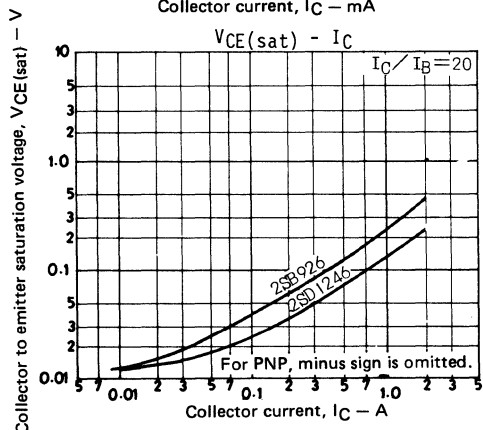
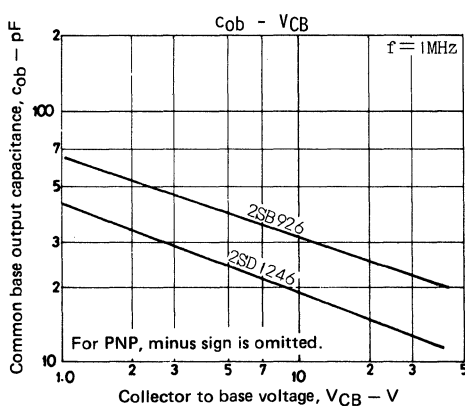
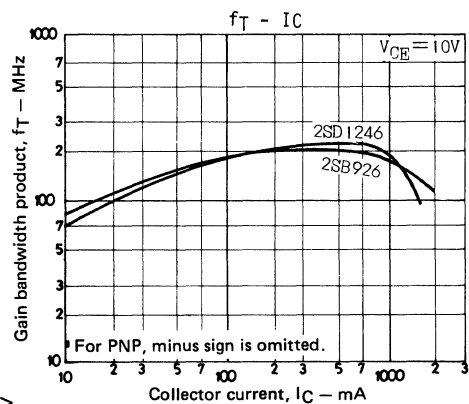
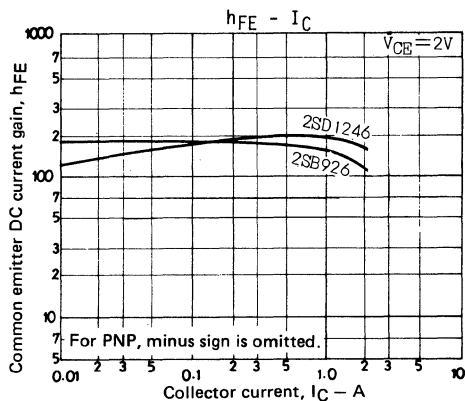
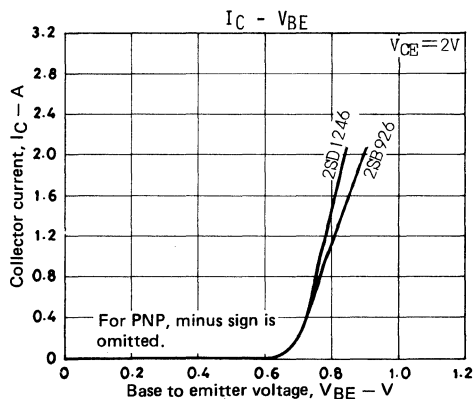
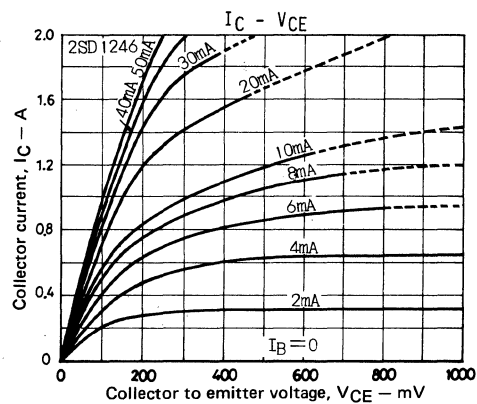
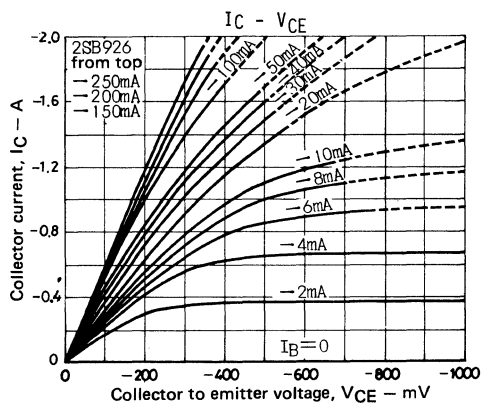
			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = (-)20\text{ V}, I_E = 0$			(-) 0.1	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = (-)4\text{ V}, I_C = 0$			(-) 0.1	μA
DC current gain	$h_{FE}(1)$	$V_{CE} = (-)2\text{ V}, I_C = (-)100\text{ mA}$	100^*		560^*	
	$h_{FE}(2)$	$V_{CE} = (-)2\text{ V}, I_C = (-)1.5\text{ A, pulse}$	65	130		
Gain bandwidth product	f_T	$V_{CE} = (-)10\text{ V}, I_C = (-)50\text{ mA}$		150		MHz
Common base output capacitance	c_{ob}	$V_{CB} = (-)10\text{ V}, f = 1\text{ MHz}$		19 (32)		pF
Collector to emitter saturation voltage	$V_{CE(sat)}$	$I_C = (-)1.5\text{ A}, I_B = (-)75\text{ mA, pulse}$		0.18 (-0.35)	0.4 (-0.6)	V
Base to emitter saturation voltage	$V_{BE(sat)}$	$I_C = (-)1.5\text{ A}, I_B = (-)75\text{ mA}$		(-) 0.85	(-) 1.2	V
Collector to base breakdown voltage	$V_{(BR)CBO}$	$I_C = (-)10\text{ }\mu\text{A}, I_E = 0$	(-) 30			V
Collector to emitter breakdown voltage	$V_{(BR)CEO}$	$I_C = (-)1\text{ mA}, R_{BE} = \infty$	(-) 25			V
Emitter to base breakdown voltage	$V_{(BR)EBO}$	$I_E = (-)10\text{ }\mu\text{A}, I_C = 0$	(-) 6			V

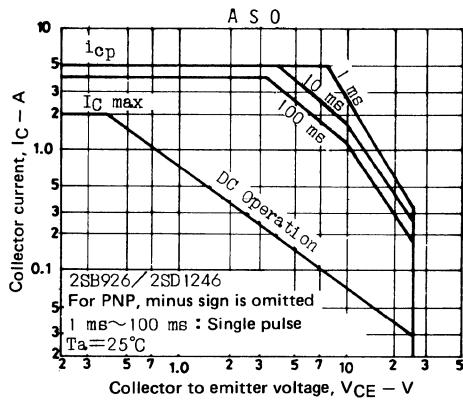
* The 2SB926/2SD1246 are classified by 100 mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400	280	U	560
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Case Outline 2003A
(unit:mm)







2SD1247



2006A

NPN/PPN Epitaxial Planar
Silicon Transistors

2SB927

High Current Switching Applications

©1029B

Applications

- Power supplies, relay drivers, lamp drivers, car applications

Features

- Adoption of FBET, MBIT process
- Low saturation voltage
- Large current capacity and wide ASO

() : 2SB927

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-) 30	V
Collector to Emitter Voltage	V_{CEO}	(-) 25	V
Emitter to Base Voltage	V_{EBO}	(-) 6	V
Collector Current	I_C	(-) 2.5	A
Peak Collector Current	i_{cp}	(-) 5	A
Collector Dissipation	P_C	1.0	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

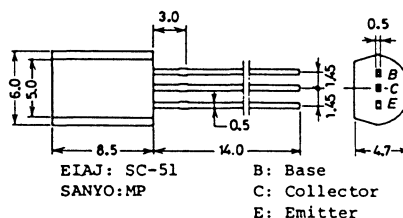
Electrical Characteristics at $T_a=25^\circ\text{C}$

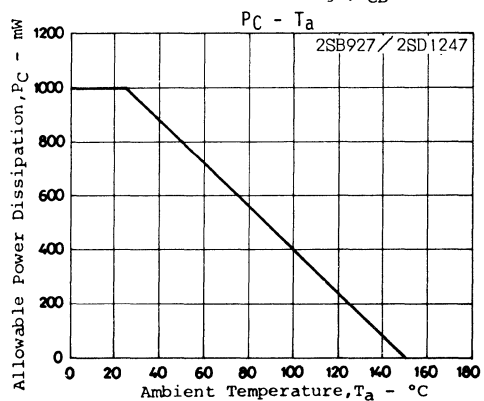
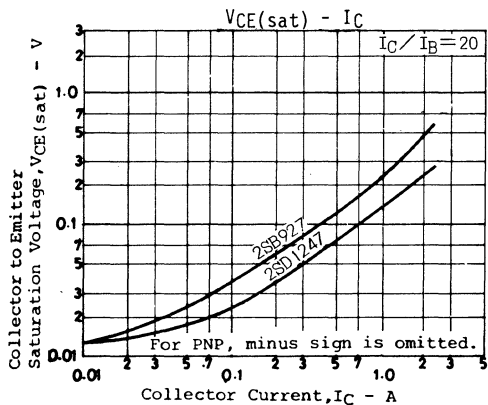
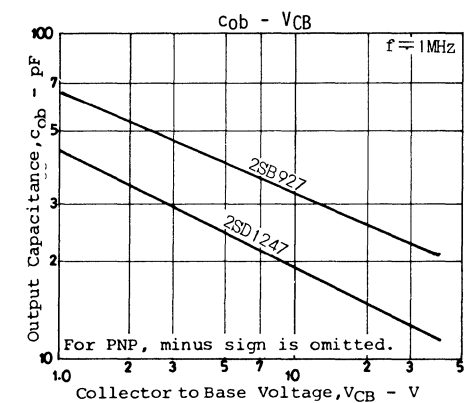
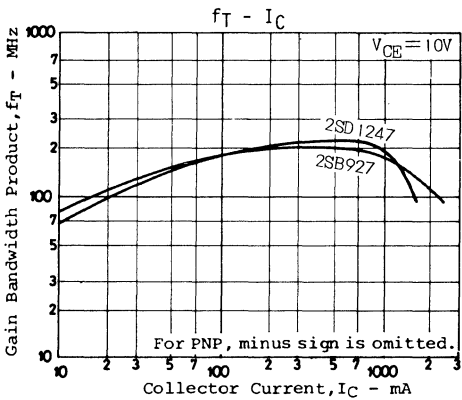
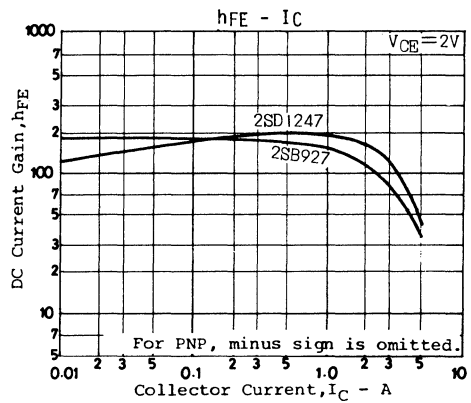
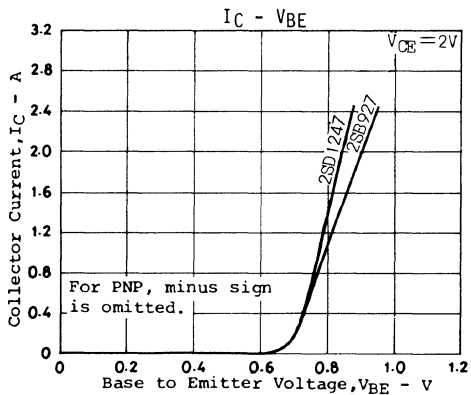
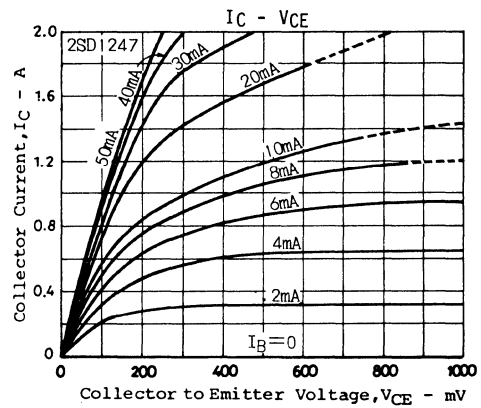
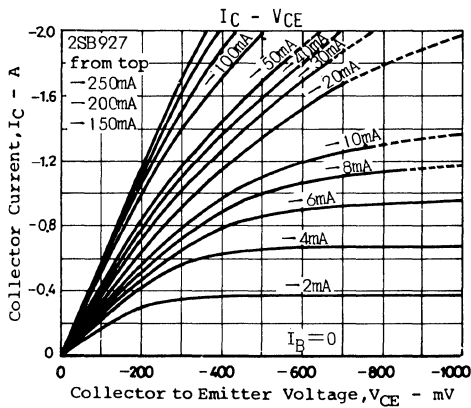
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)20\text{V}, I_E=0$		(-) 0.1		μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$		(-) 0.1		μA
DC Current Gain	$h_{FE(1)}$	$V_{CE}=(-)2\text{V}, I_C=(-)0.1\text{A}$	100*		560*	
	$h_{FE(2)}$	$V_{CE}=(-)2\text{V}, I_C=(-)1.5\text{A}$	65	130		
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		150		MHz
Common Base Output Capacitance	C_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		19 (32)		pF
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)1.5\text{A}, I_B=(-)75\text{mA}$	0.18	0.4		V
			(-0.35)	(-0.6)		
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)1.5\text{A}, I_B=(-)75\text{mA}$	0.85	1.2		V

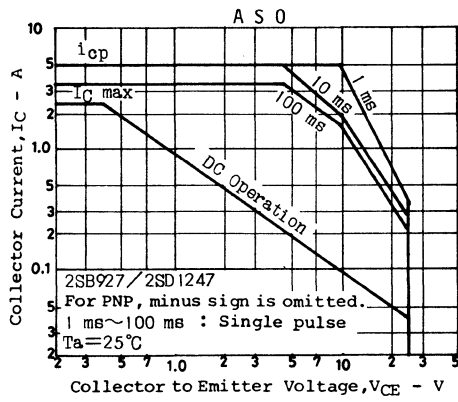
* The 2SB927/2SD1247 are classified by 0.1A h_{FE} as follows :

100	R	200	140	S	280	200	T	400	280	U	560
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Case Outline 2006A (unit:mm)







2SD1347



2006A

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB985

High Current Driver Applications

©1244B

Applications

- Power Supplies, relay drivers, lamp drivers, car applications

Features

- Adoption of FBET, MBIT process
- Low saturation voltage
- Large current capacity and wide ASO

() : 2SB985

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	(-) 60	V
Collector to Emitter Voltage	V_{CEO}	(-) 50	V
Emitter to Base Voltage	V_{EBO}	(-) 6	V
Collector Current	I_C	(-) 3	A
Peak Collector Current	i_{cp}	(-) 6	A
Collector Dissipation	P_C	1	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

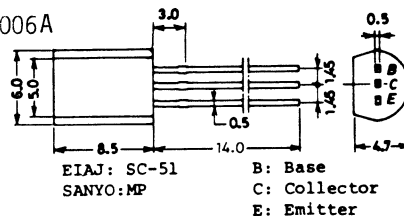
Electrical Characteristics at $T_a=25^\circ\text{C}$

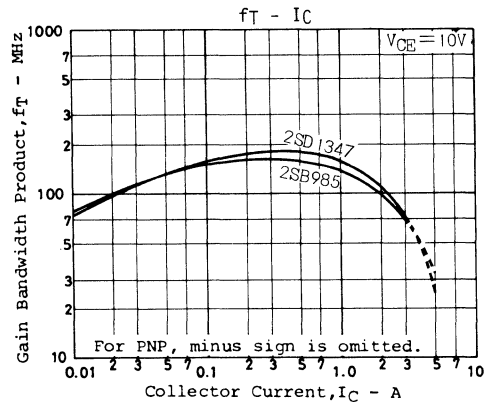
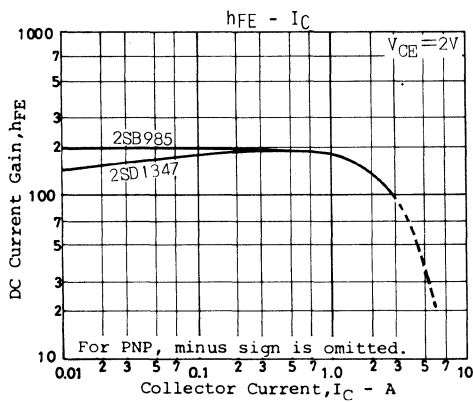
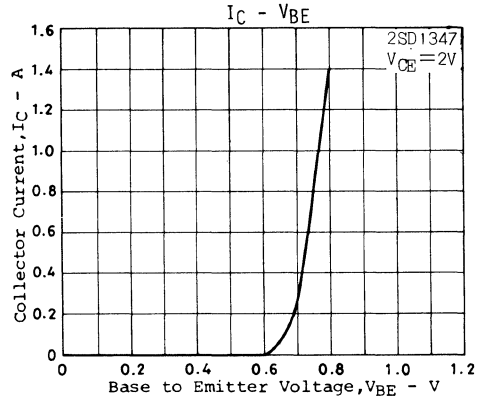
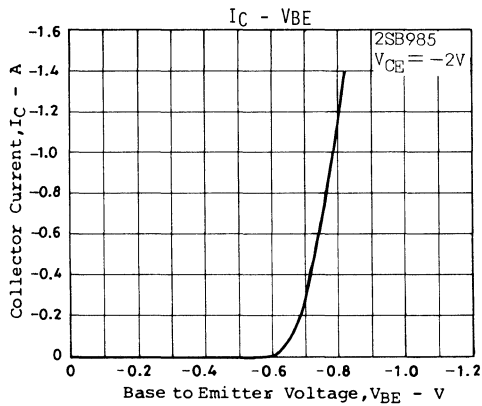
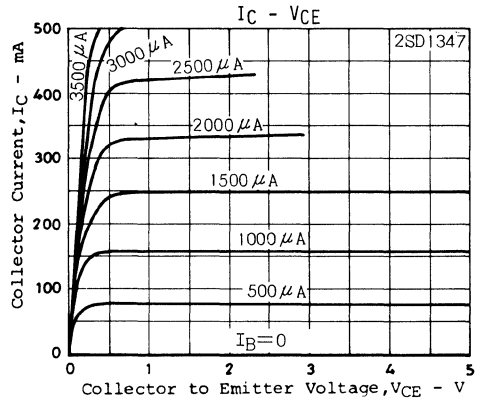
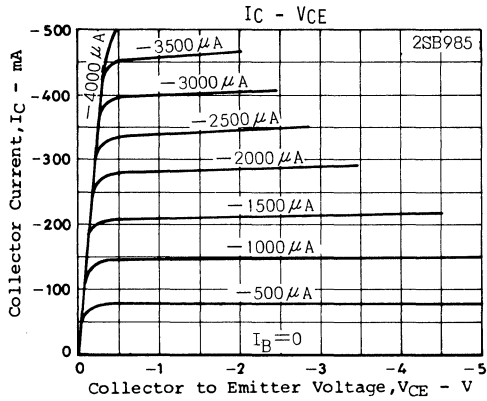
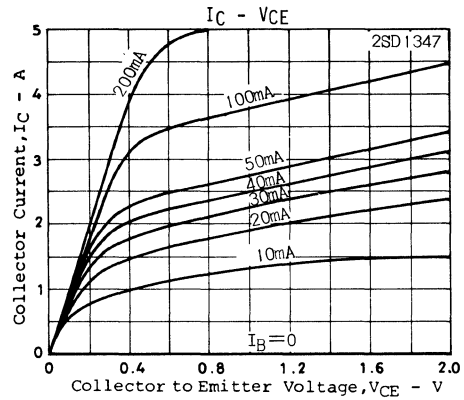
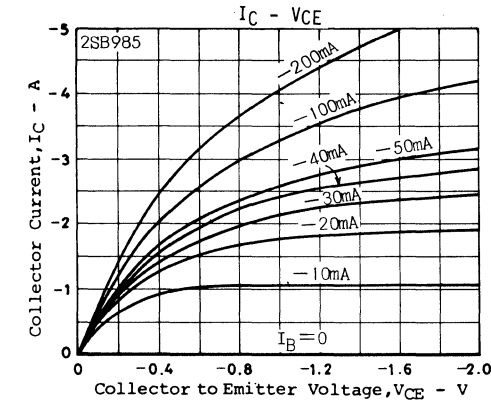
			min	typ	max	unit
Collector Cutoff Current	V_{CBO}	$V_{CB}=(-)40\text{V}, I_E=0$		(-) 1.0		μA
Emitter Cutoff Current	V_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$		(-) 1.0		μA
DC Current Gain	$h_{FE}(1)$	$V_{CE}=(-)2\text{V}, I_C=(-)100\text{mA}$	100*		560*	
	$h_{FE}(2)$	$V_{CE}=(-)2\text{V}, I_C=(-)3\text{A}$	40			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		150		MHz
Output Capacitance	C_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		25		pF
				(39)		
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)2\text{A}, I_B=(-)100\text{mA}$, Pulse		0.19	0.5	V
				(-0.35)	(-0.7)	
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)2\text{A}, I_B=(-)100\text{mA}$, Pulse		(-) 0.94	(-) 1.2	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}, I_E=0$		(-) 60		V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}, R_{BE}=\infty$		(-) 50		V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}, I_C=0$		(-) 6		V

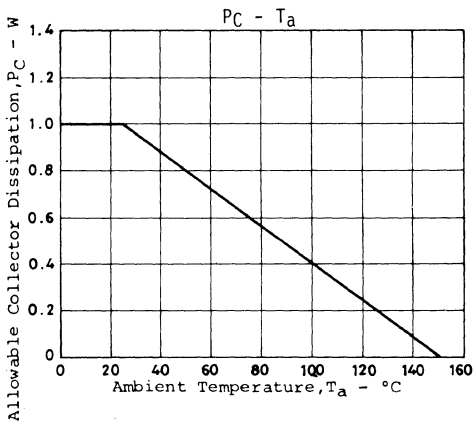
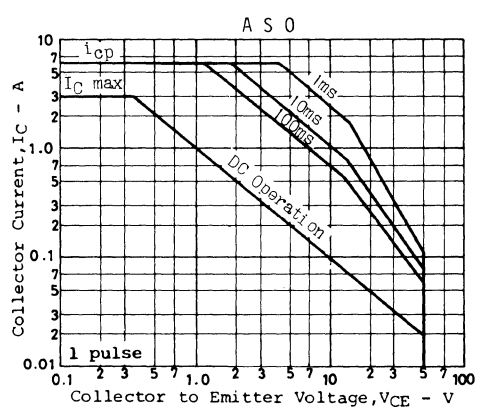
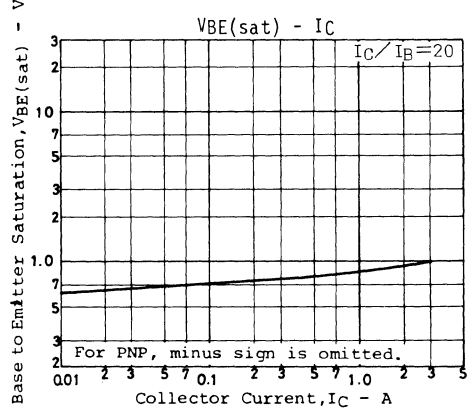
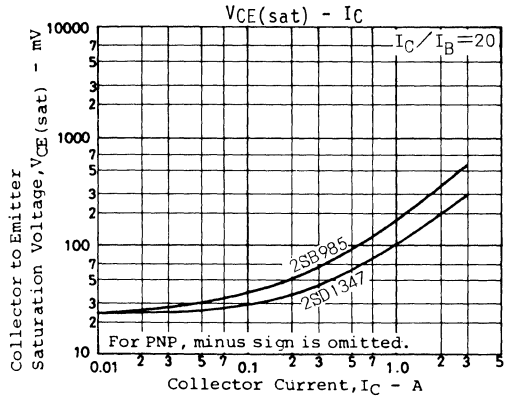
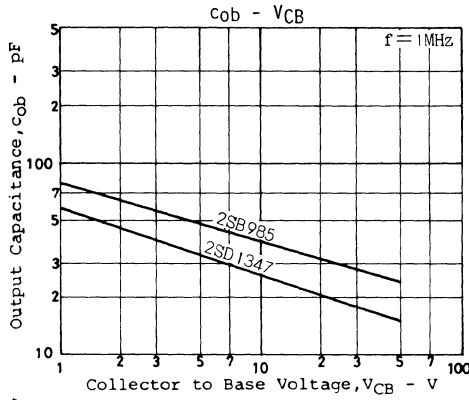
*The 2SB985/2SD1347 are classified by 100mA h_{FE} as follows :

100	R	200	140	S	280	200	T	400	280	U	560
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Case Outline 2006A
(unit:mm)







2SD1348



2009

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB986

High Current Switching Applications

©1245A

Use

- . Power supply, relay driver, lamp driver, electrical equipment.

Features

- . Adoption of FBET, MBIT process.
- . Low saturation voltage.
- . Large current capacity and wide ASO.

():2SB986

Absolute Maximum Ratings at Ta=25°C

Absolute Maximum Ratings at Ta=25°C			unit
Collector to Base Voltage	V _{CB0}	(-)60	V
Collector to Emitter Voltage	V _{CEO}	(-)50	V
Emitter to Base Voltage	V _{EB0}	(-)6	V
Collector Current	I _C	(-)4	A
Peak Collector Current	i _{cp}	(-)6	A
Collector Dissipation	P _C	1.2	W
	Tc=25°C	10	W
Junction Temperature	Tj	150	°C
Storage Temperature	Tstg	-55 to +150	°C

Electrical Characteristics at Ta=25°C

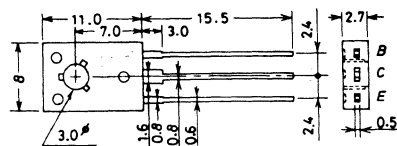
			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)40V, I_E=0$			(-)1.0	uA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)4V, I_C=0$			(-)1.0	uA
DC Current Gain	$h_{FE(1)}$	$V_{CE}=(-)2V, I_C=(-)100mA$	100*		560*	
	$h_{FE(2)}$	$V_{CE}=(-)2V, I_C=(-)3A$	40			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		150		MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10V$		25		pF
				(39)		

* The 2SB986/2SD1348 are classified by 100mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400	280	U	560
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Case Outline 2009

(unit:mm)

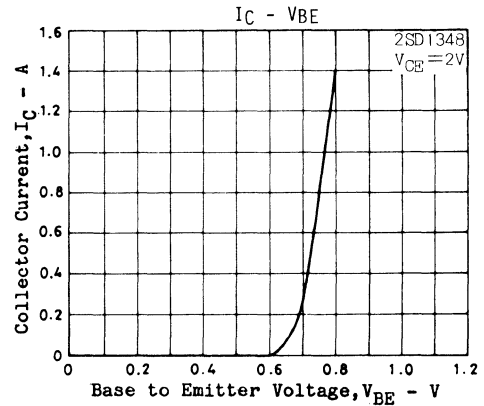
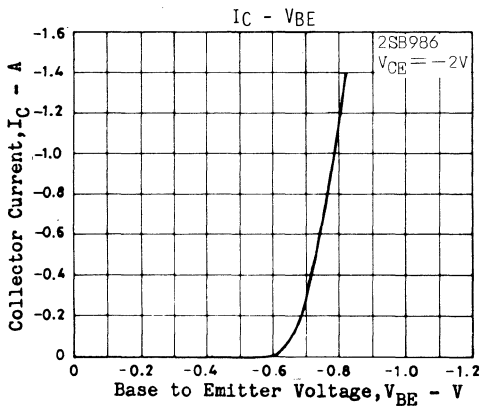
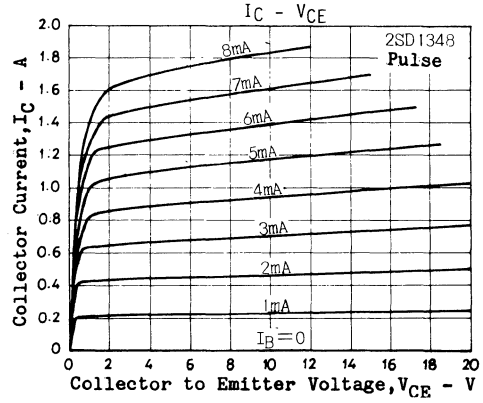
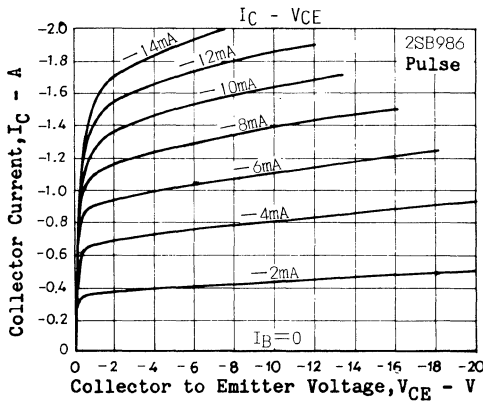
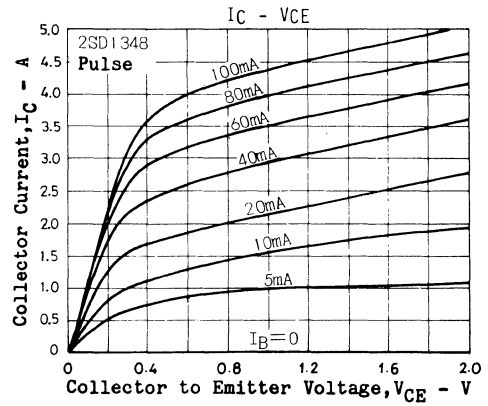
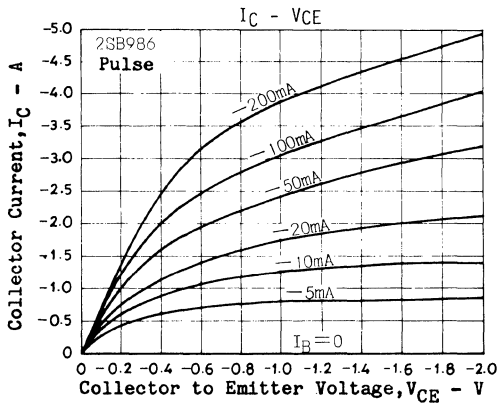


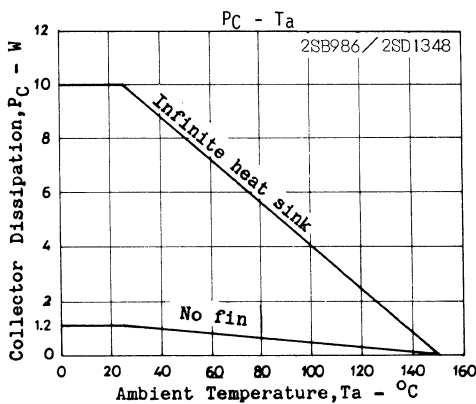
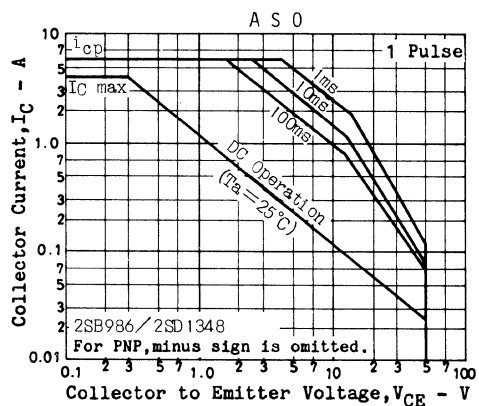
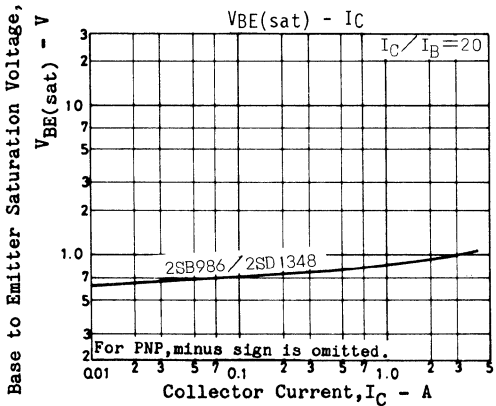
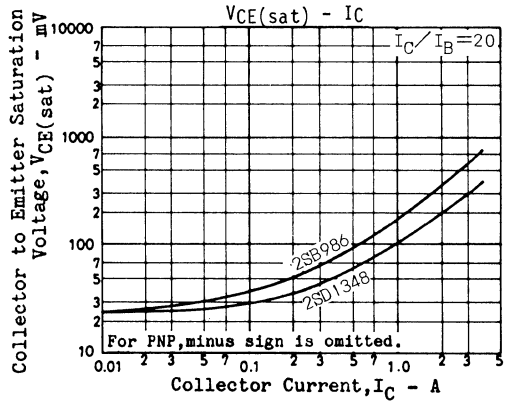
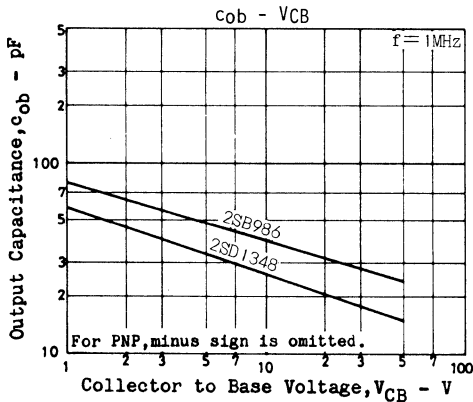
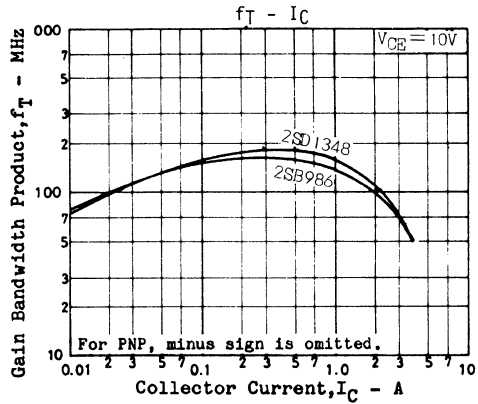
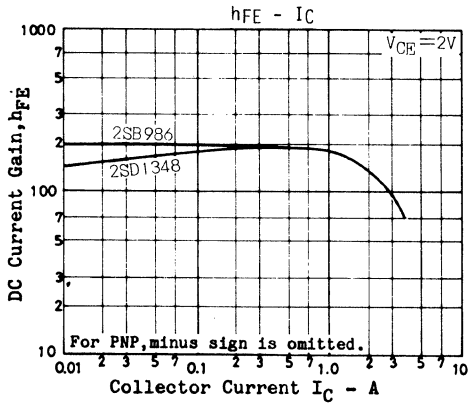
JEDEC: TO-126

B: Base
C: Collector
E: Emitter

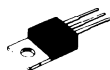
D124MY, TS No.1245-1/3

			min	typ	max	unit
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)2A$, $I_B=(-)100mA$, Pulse		0.19	0.5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)2A$, $I_B=(-)100mA$, Pulse		(-0.35) (-0.7)		V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=10uA$, $I_E=0$	(-)60			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=1mA$, $R_{BE}=\infty$	(-)50			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10uA$, $I_C=0$	(-)6			V





2SD1394



2010A

NPN Triple Diffused Planar
Silicon Darlington Transistor

Driver Applications

©1220

Use:

- Especially suited for use in switching of L load of motor driver, printer hammer driver, relay driver, etc.

Features:

- High DC current gain
- Large current capacity and wide ASO
- Contains $60 \pm 10V$ avalanche diode between collector and base
- Uniformity in collector-to-base breakdown voltage due to adoption of accurate impurity diffusion process
- High 40mJ reverse energy rating

Absolute Maximum Ratings at $T_a = 25^\circ C$

			unit
Collector to Base Voltage	V_{CB0}	50*	V
Collector to Emitter Voltage	V_{CE0}	50*	V
Emitter to Base Voltage	V_{EB0}	6	V
Collector Current	I_C	3	A
Peak Collector Current	i_{cp}	5	A
Base Current	I_B	0.5	A
Collector Dissipation	P_C	30	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

unit

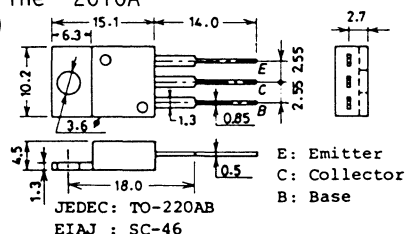
*: Built-in
Zener Diode
($60 \pm 10V$)

Electrical Characteristics at $T_a = 25^\circ C$

			Min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = 40V, I_E = 0$			100	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 5V, I_C = 0$			3	mA
DC Current Gain	h_{FE}	$V_{CE} = 3V, I_C = 1.5A$	1000	4000		
Gain Bandwidth Product	f_T	$V_{CE} = 5V, I_C = 1.5A$		20		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = 1.5A, I_B = 3mA$		0.9	1.5	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = 1.5A, I_B = 3mA$			2.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 5mA, I_E = 0$	50	60	70	V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 50mA, R_{BE} = \infty$	50	60	70	V
Unclamped Inductive Load Energy	Es/b	$L = 100mH, R_{BE} = 100\Omega$	40			mJ
Turn-on Time	t_{on}	$V_{CC} = 20V, I_C = 2.0A$		0.5		μs
Storage Time	t_{stg}	$I_{B1} = -I_{B2} = 4mA$		4.0		μs
Fall Time	t_f			1.5		μs

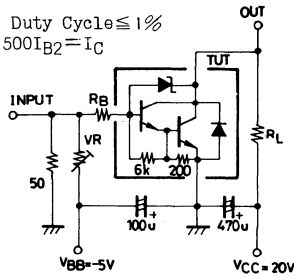
Switching time is measured with the specified test circuit shown on the next page.

Case Outline 2010A (unit:mm)



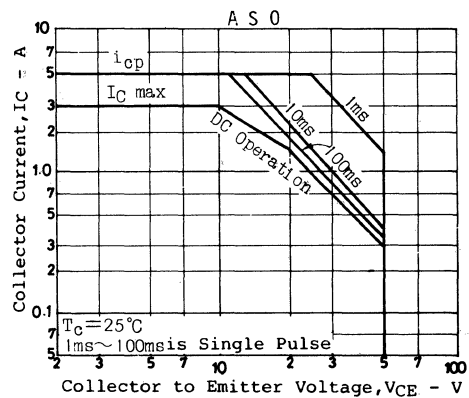
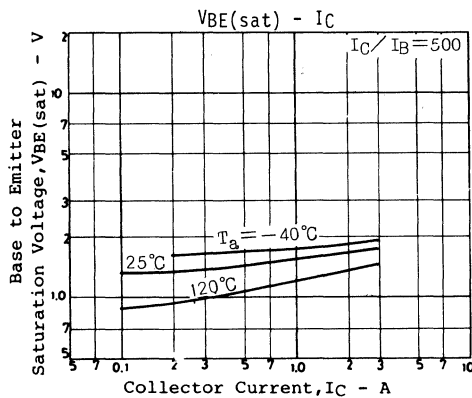
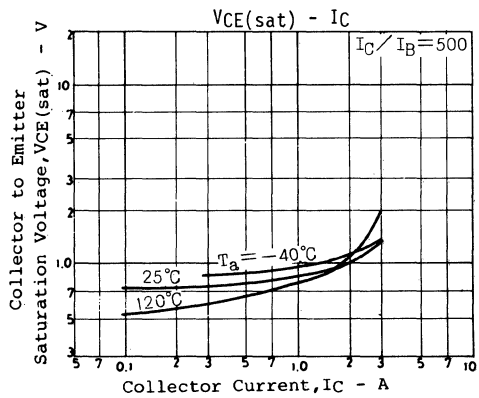
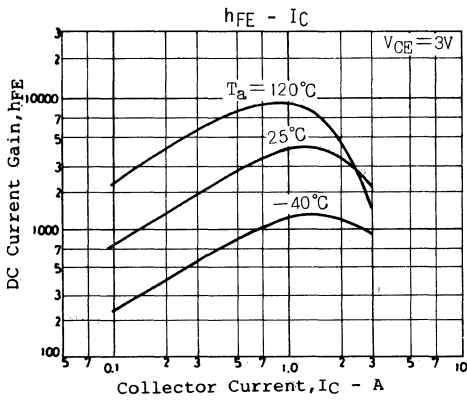
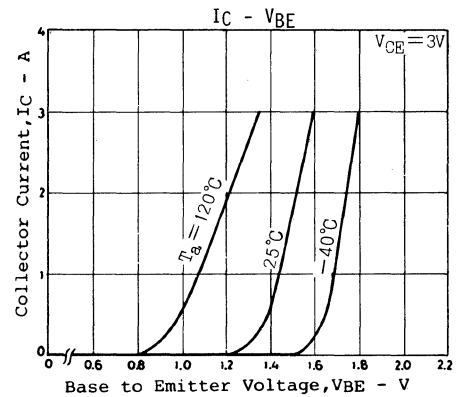
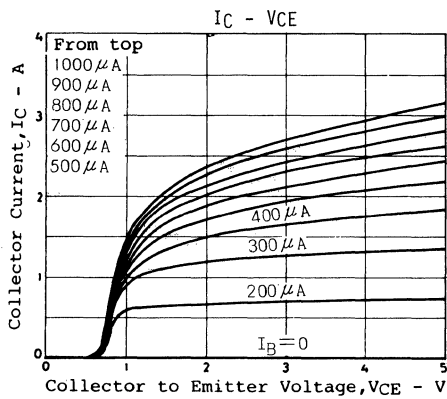
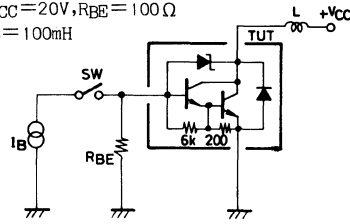
Switching Time Test Circuit

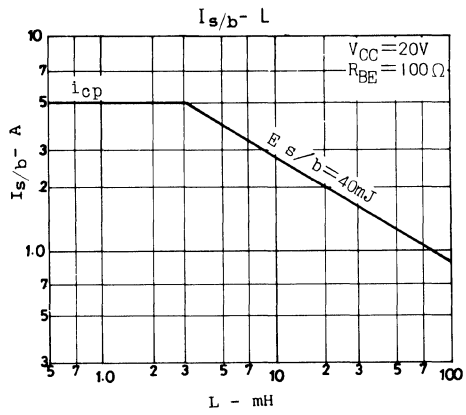
$PW = 50 \mu s$, Duty Cycle $\leq 1\%$
 $500I_{B1} = -500I_{B2} = I_C$

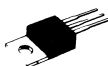


Es/b Test Circuit

$V_{CC} = 20V$, $R_{BE} = 100 \Omega$
 $L = 100mH$







Driver Applications

©1221

Use:

- Especially suited for use in switching of L load of motor driver, printer hammer driver, relay driver, etc.

Features:

- High DC current gain
- Large current capacity and wide ASO
- Contains $60 \pm 10V$ avalanche diode between collector and base
- Uniformity in collector-to-base breakdown voltage due to adoption of accurate impurity diffusion process
- High 50mJ reverse energy rating

Absolute Maximum Ratings at $T_a = 25^\circ C$

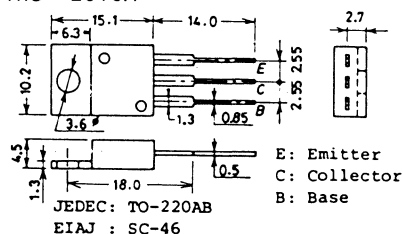
			unit	
Collector to Base Voltage	V_{CBO}	50*	V	*: Built-in
Collector to Emitter Voltage	V_{CEO}	50*	V	Zener Diode
Emitter to Base Voltage	V_{EBO}	6	V	($60 \pm 10V$)
Collector Current	I_C	5	A	
Peak Collector Current	i_{cp}	8	A	
Base Current	I_B	0.5	A	
Collector Dissipation	P_C	$T_c = 25^\circ C$	40	W
Junction Temperature	T_j	150	$^\circ C$	
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$	

Electrical Characteristics at $T_a = 25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB} = 40V, I_E = 0$			100	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 5V, I_C = 0$			3	mA
DC Current Gain	h_{FE}	$V_{CE} = 3V, I_C = 2.5A$	1000	4000		
Gain Bandwidth Product	f_T	$V_{CE} = 5V, I_C = 2.5A$		20		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C = 2.5A, I_B = 5mA$		0.9	1.5	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C = 2.5A, I_B = 5mA$			2.0	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 5mA, I_E = 0$	50	60	70	V
C-E Saturation Voltage	$V_{(BR)CEO}$	$I_C = 50mA, R_{BE} = \infty$	50	60	70	V
Unclamped Inductive Load	Es/b	$L = 100mH, R_{BE} = 100\Omega$	50			mJ
Energy						
Turn-on Time	t_{on}	$[V_{CC} = 20V, I_C = 3.0A]$		0.6		μs
Storage Time	t_{stg}	$[I_{B1} = -I_{B2} = 6mA]$		4.0		μs
Fall Time	t_f			1.5		μs

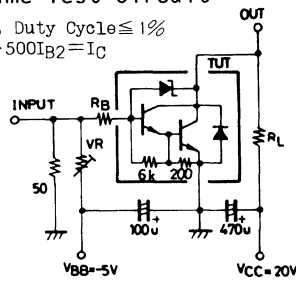
Switching time is measured with the specified test circuit shown on the next page.

Case Outline 2010A (unit:mm)



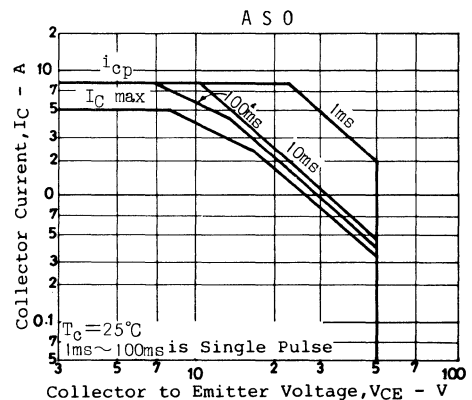
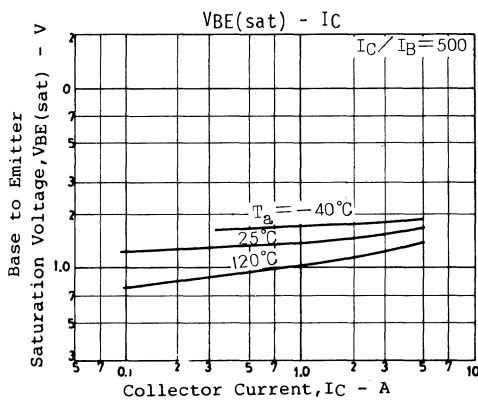
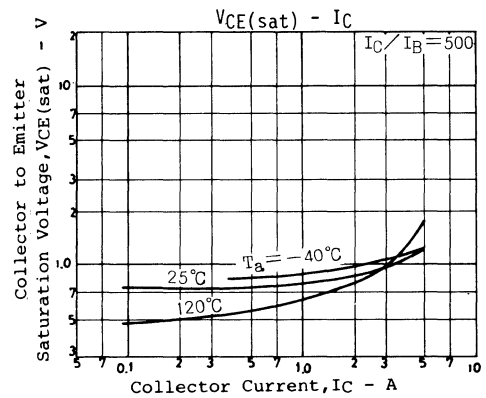
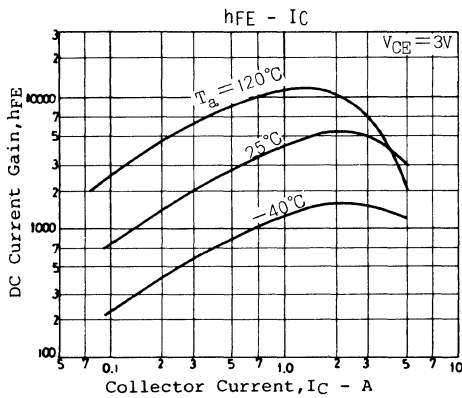
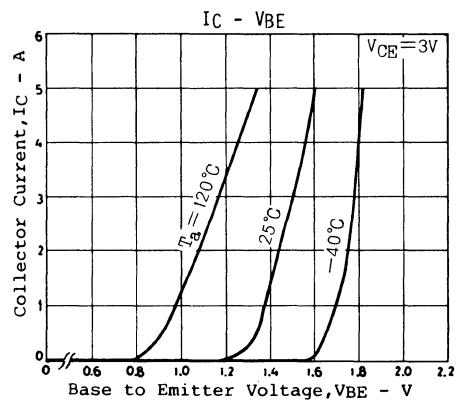
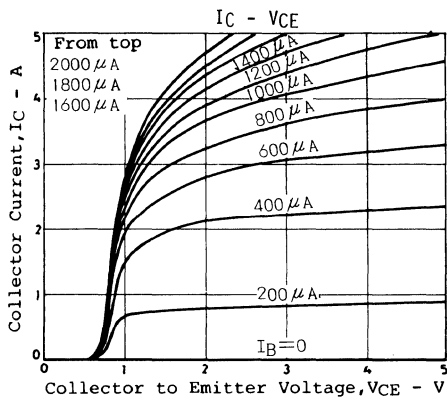
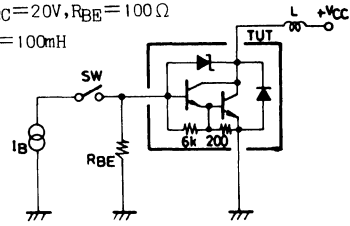
Switching Time Test Circuit

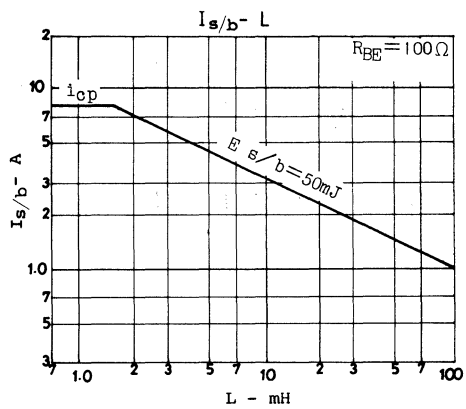
$PW=50\mu s$, Duty Cycle $\leq 1\%$
 $500I_{B1} = -500I_{B2} = I_C$



Es/b Test Circuit

$V_{CE}=20V$, $R_{BE}=100\Omega$
 $L=100mH$





2SD1396



2022

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications (with Damper Diode)

©1222A

Features:

- High Breakdown Voltage and High Reliability.
- High Switching Speed.
- Capable of being mounted easily due to one-point fixing type plastic mold package.

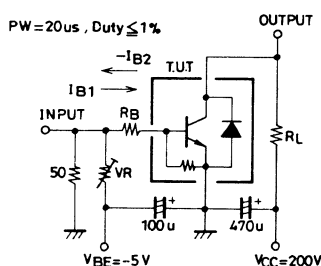
Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_C	2.5	A
Peak Collector Current	i_{cp}	10	A
Collector Dissipation	P_C	80	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

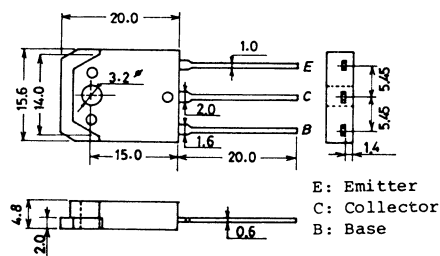
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

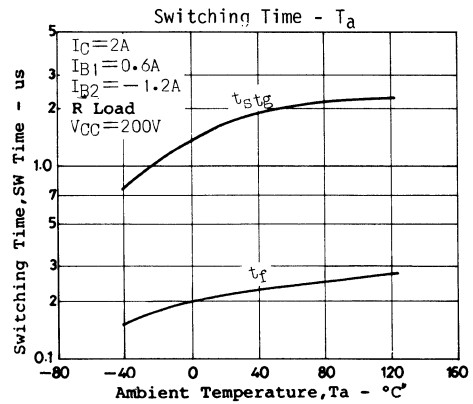
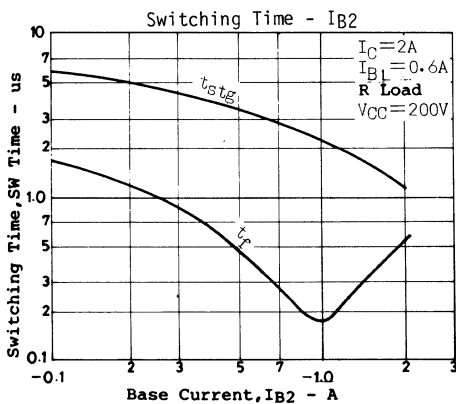
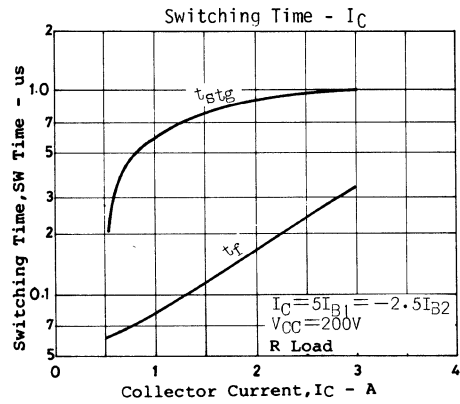
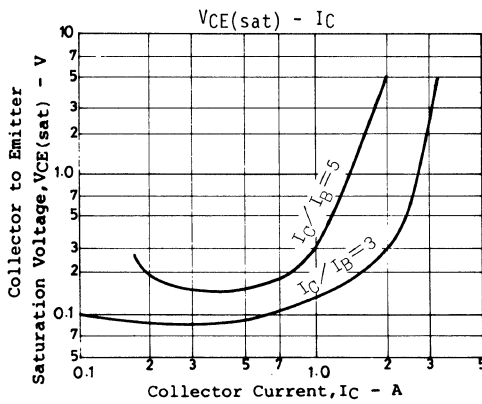
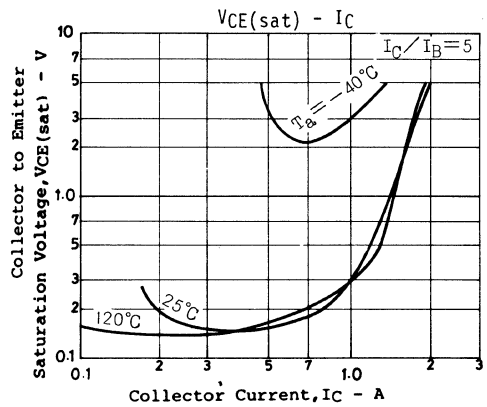
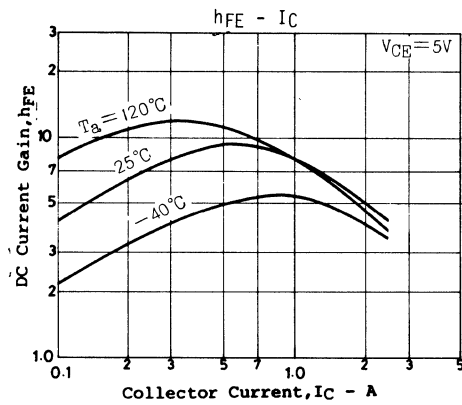
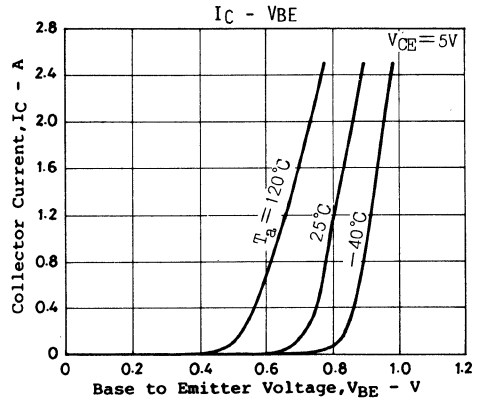
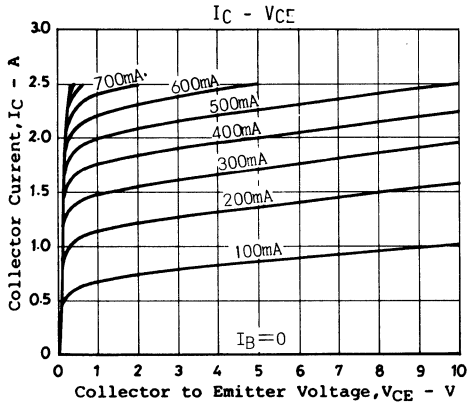
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800\text{V}, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4\text{V}, I_C=0$	40		130	mA
DC Current Gain	h_{FE}	$V_{CE}=5\text{V}, I_C=0.5\text{A}$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=0.5\text{A}$		3		MHz
C-E Saturation Voltage	$V_{CE}(\text{sat})$	$I_C=2\text{A}, I_B=0.6\text{A}$			8	V
B-E Saturation Voltage	$V_{BE}(\text{sat})$	$I_C=2\text{A}, I_B=0.6\text{A}$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5\text{mA}, I_E=0$	1500			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=100\text{mA}, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=200\text{mA}, I_C=0$	7			V
Diode Forward Voltage	V_F	$I_{EC}=2.5\text{A}$			2	V
Fall Time	t_f	$I_C=2\text{A}, I_{B1}=0.6\text{A}, I_{B2}=-1.2\text{A}$ $V_{CC}=200\text{V}, R_L=100\Omega$			0.7	μs

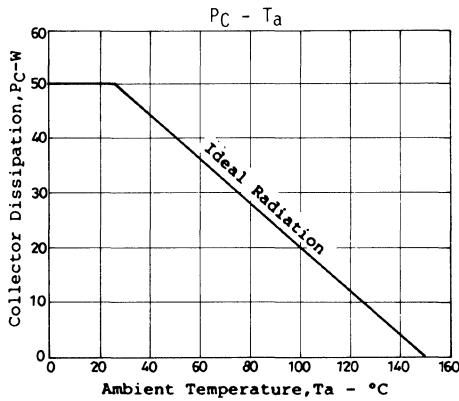
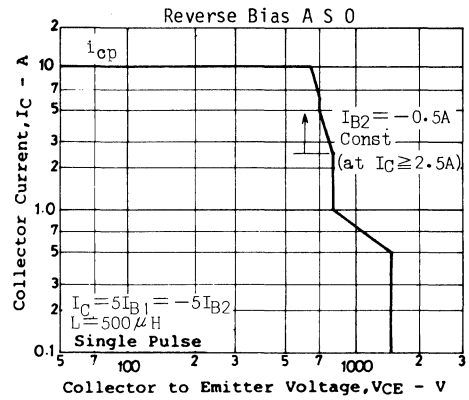
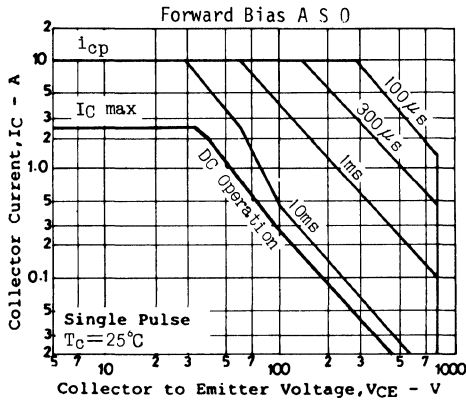
Switching Time Test Circuit



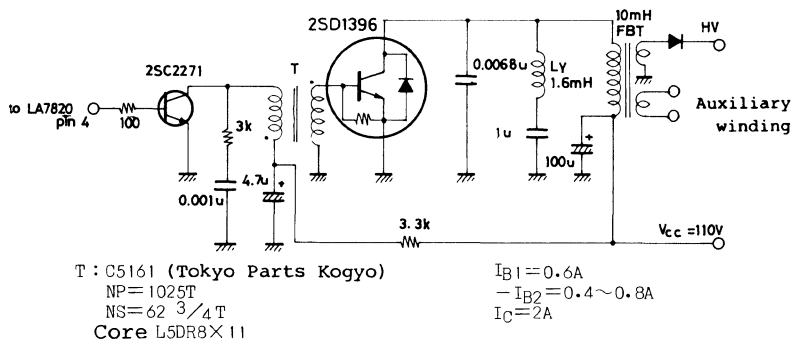
Case Outline 2022 (unit:mm)



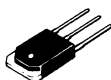




Sample Application Circuit



2SD1397



2022

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications (with Damper Diode)

©1223A

Features:

- High Breakdown Voltage and High Reliability.
- High Switching Speed.
- Capable of being mounted easily due to one-point fixing type plastic mold package.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

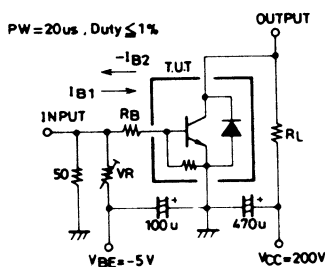
			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_C	3.5	A
Peak Collector Current	i_{cp}	10	A
Collector Dissipation	P_C	80	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

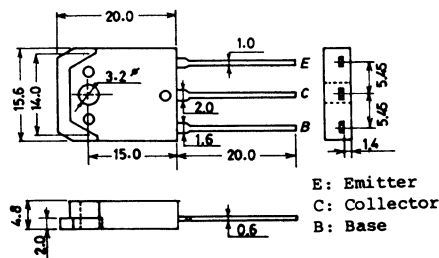
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800\text{V}, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4\text{V}, I_C=0$	40		130	mA
DC Current gain	h_{FE}	$V_{CE}=5\text{V}, I_C=0.5\text{A}$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=0.5\text{A}$		3		MHz
C-E Saturation Voltage	$V_{CE}(\text{sat})$	$I_C=2.5\text{A}, I_B=0.8\text{A}$			8	V
B-E Saturation Voltage	$V_{BE}(\text{sat})$	$I_C=2.5\text{A}, I_B=0.8\text{A}$			1.5	V
C-B Breakdown Voltage	$V(\text{BR})_{CBO}$	$I_C=5\text{mA}, I_E=0$	1500			V
C-E Breakdown Voltage	$V(\text{BR})_{CEO}$	$I_C=100\text{mA}, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V(\text{BR})_{EBO}$	$I_E=200\text{mA}, I_C=0$	7			V
Diode Forward Voltage	V_F	$I_{EC}=3.5\text{A}$			2	V
Fall Time	t_f	$I_C=3\text{A}, I_{B1}=0.8\text{A}, I_{B2}=-1.6\text{A}$			0.7	μs

$V_{CC}=200\text{V}, R_L=66.7\text{ohm}$

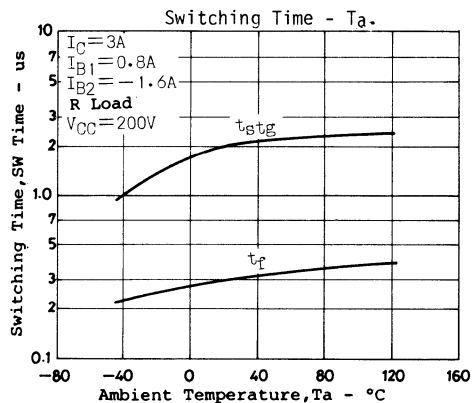
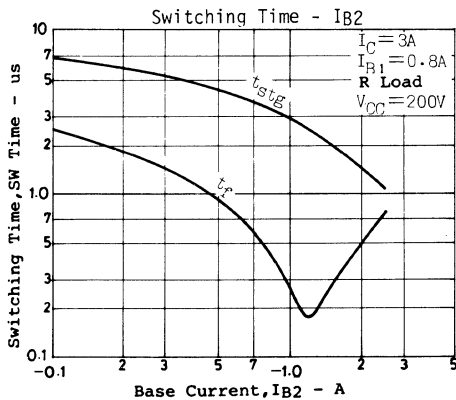
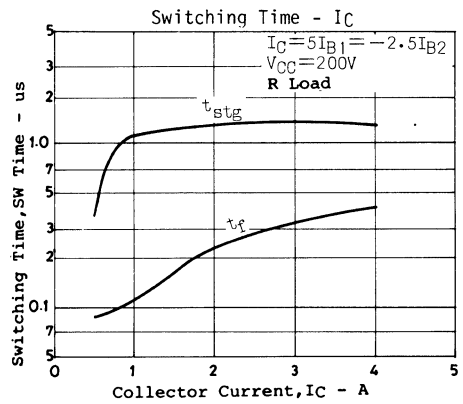
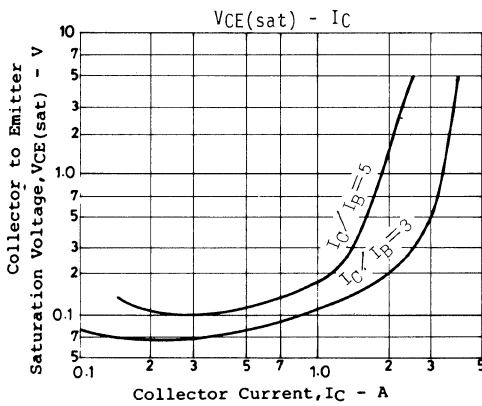
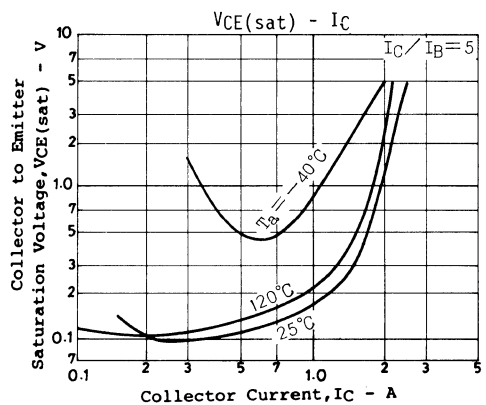
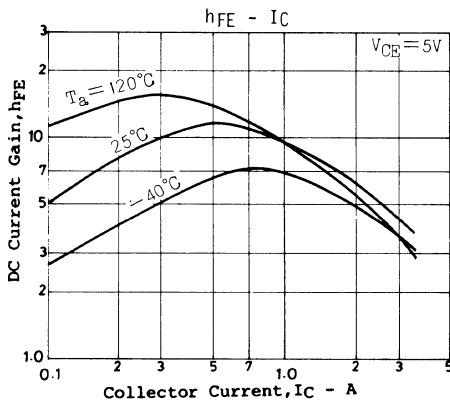
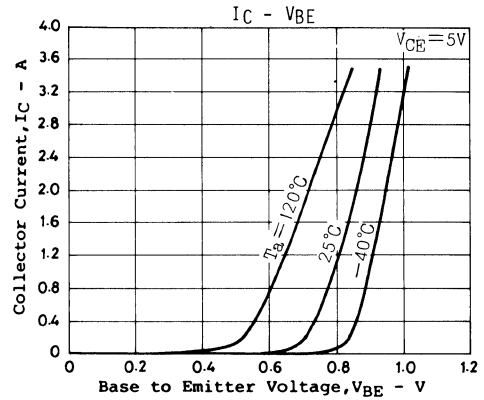
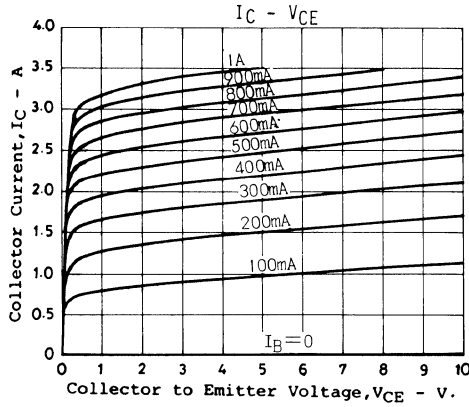
Switching Time Test Circuit

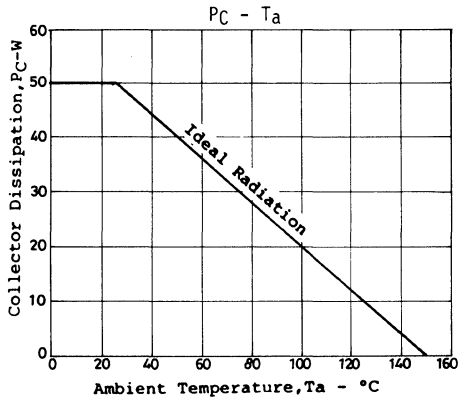
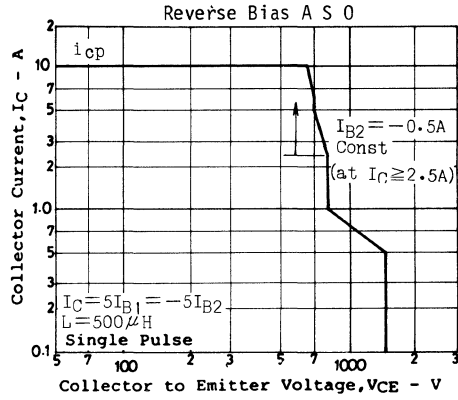
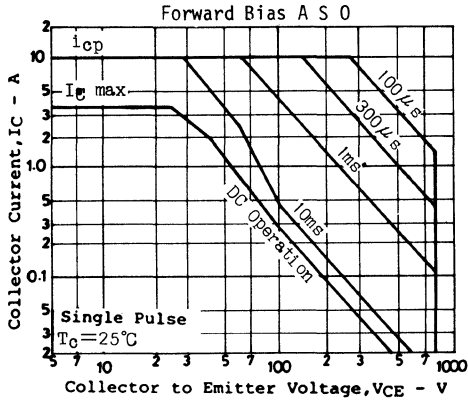


Case Outline 2022 (unit:mm)

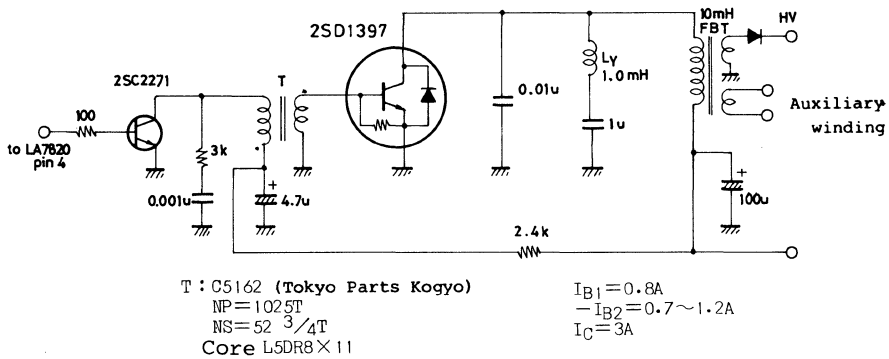


2275MY/1203KI,MT No.1223-1/3





Sample Application Circuit





2022

NPN Triple Diffused Planar Silicon Transistor

Color TV Horizontal Deflection Output Applications (with Damper Diode)

①1224A

Features

- . High breakdown voltage and high reliability.
- . High switching speed.
- . Capable of being mounted in a variety of methods because of plastic molded package of one-point fixing type.

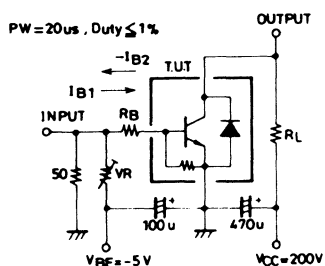
Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

Solute Maximum Ratings at $T_a=25^{\circ}\text{C}$			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_{C}	5	A
Peak Collector Current	i_{cp}	16	A
Collector Dissipation	P_{C}	120	W
Junction Temperature	T_{j}	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

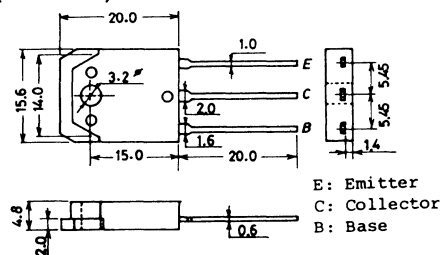
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

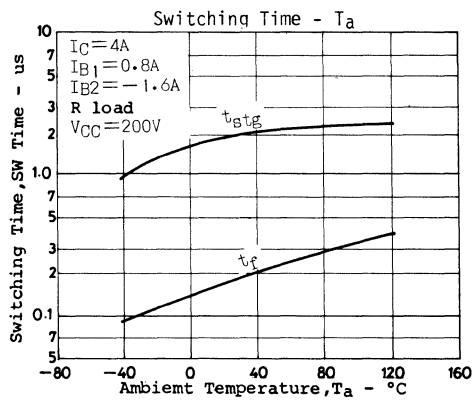
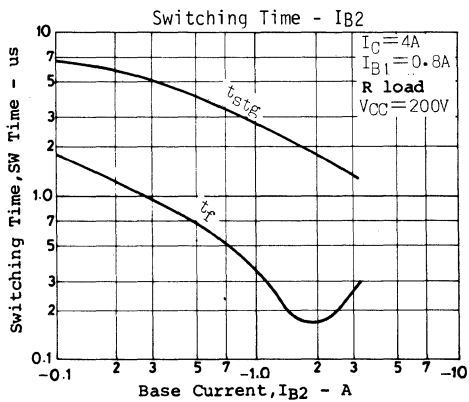
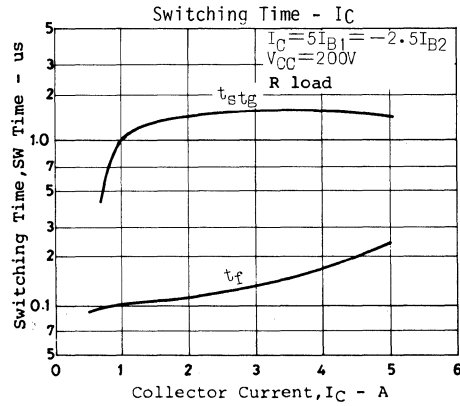
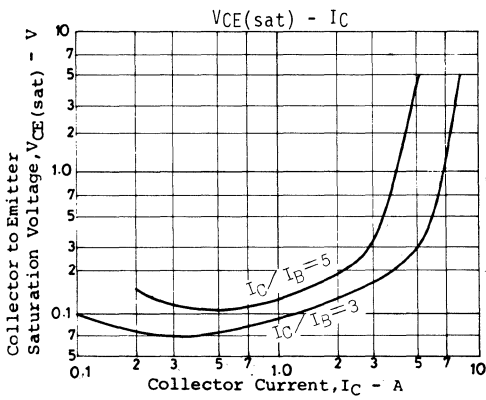
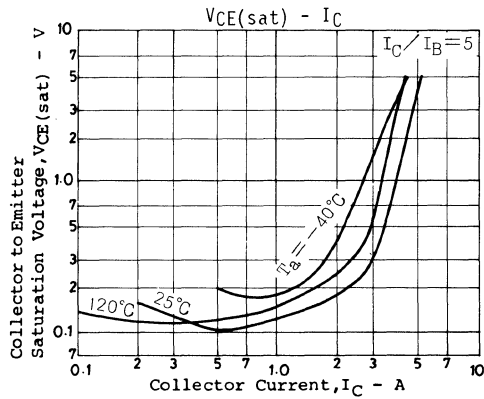
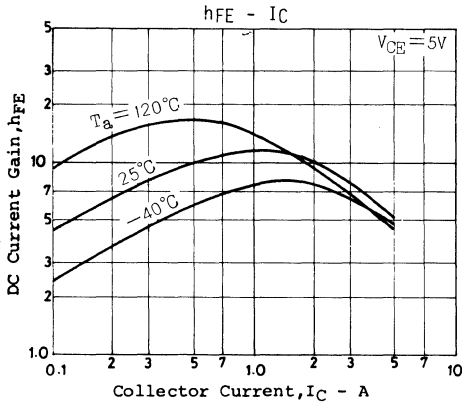
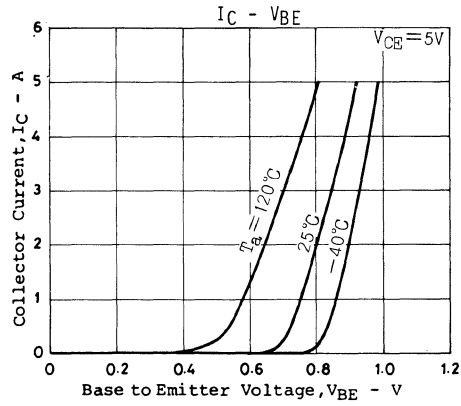
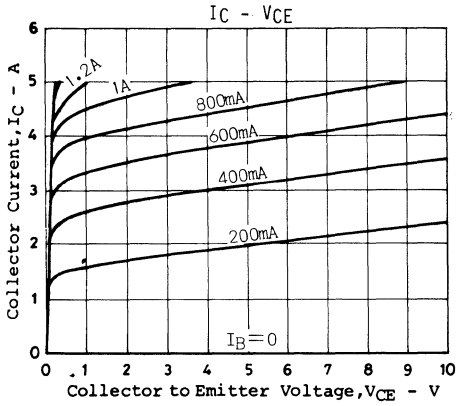
Electrical Characteristics at $T_a=25^{\circ}\text{C}$			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{\text{CB}}=800\text{V}, I_{\text{E}}=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{\text{EB}}=4\text{V}, I_{\text{C}}=0$	40		130	mA
DC Current Gain	h_{FE}	$V_{\text{CE}}=5\text{V}, I_{\text{C}}=1\text{A}$	8			
Gain Bandwidth Product	f_{T}	$V_{\text{CE}}=10\text{V}, I_{\text{C}}=1\text{A}$		3		MHz
Collector to Emitter Saturation Voltage	$V_{\text{CE(sat)}}$	$I_{\text{C}}=4\text{A}, I_{\text{B}}=0.8\text{A}$			5	V
Base to Emitter Saturation Voltage	$V_{\text{BE(sat)}}$	$I_{\text{C}}=4\text{A}, I_{\text{B}}=0.8\text{A}$			1.5	V
Collector to Base Breakdown Voltage	$V_{(\text{BR})\text{CBO}}$	$I_{\text{C}}=5\text{mA}, I_{\text{E}}=0$	1500			V
Collector to Emitter Breakdown Voltage	$V_{(\text{BR})\text{CEO}}$	$I_{\text{C}}=100\text{mA}, R_{\text{BE}}=\infty$	800			V
Emitter to Base Breakdown Voltage	$V_{(\text{BR})\text{EBO}}$	$I_{\text{E}}=200\text{mA}, I_{\text{C}}=0$	7			V
Diode Forward Voltage	V_{F}	$I_{\text{EC}}=5\text{A}$			2	V
Fall Time	t_{f}	$I_{\text{C}}=4\text{A}, I_{\text{B1}}=0.8\text{A}, I_{\text{B2}}=-1.6\text{A}, V_{\text{CC}}=200\text{V}, R_{\text{L}}=50\text{ohm}$			0.7	μs

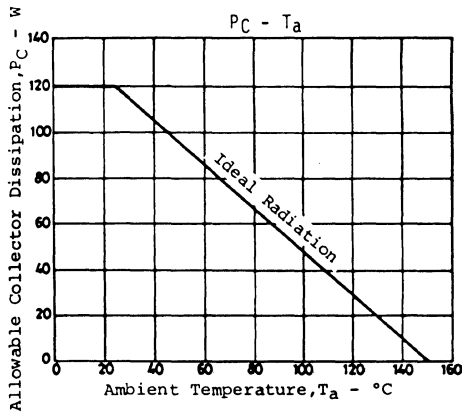
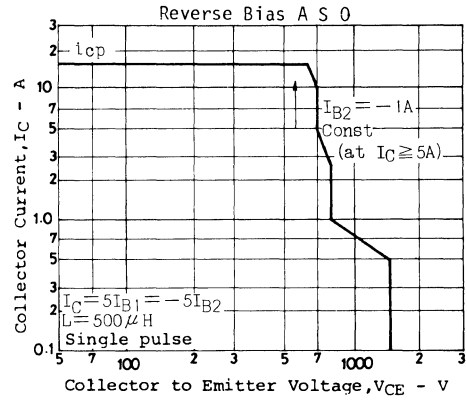
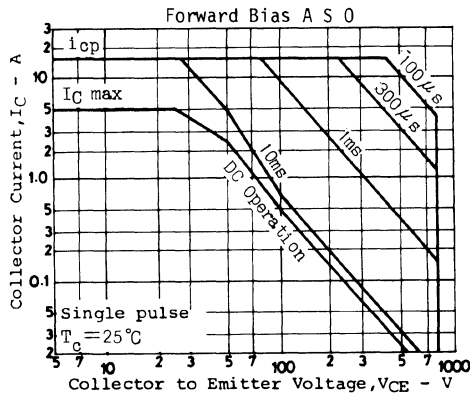
Switching Time Test Circuit



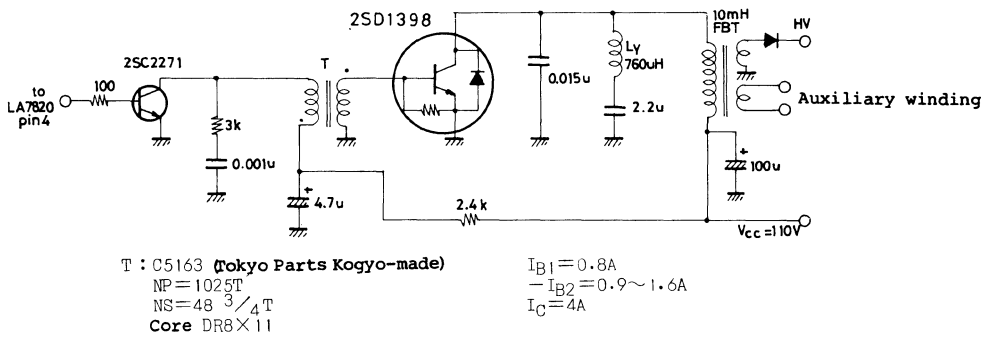
Case Outline 2022
(unit:mm)



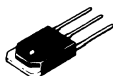




Sample Application Circuit



2SD1399



2022

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications (with Damper Diode)

©1225A

Features:

- High Breakdown Voltage and High Reliability.
- High Switching Speed.
- Capable of being mounted easily due to one-point fixing type plastics mold package.

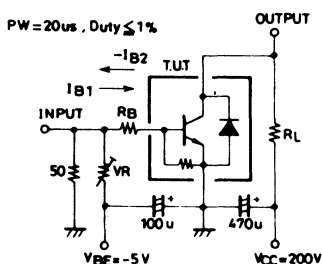
Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_C	6	A
Peak Collector Current	i_{cp}	16	A
Collector Dissipation	P_C	120	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

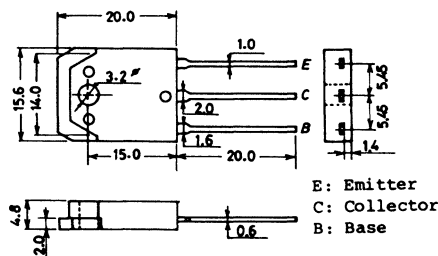
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800\text{V}, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4\text{V}, I_C=0$	40		130	mA
DC Current Gain	h_{FE}	$V_{CE}=5\text{V}, I_C=1\text{A}$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=1\text{A}$		3		MHz
C-E Saturation Voltage	$V_{CE}(\text{sat})$	$I_C=5\text{A}, I_B=1\text{A}$			5	V
B-E Saturation Voltage	$V_{BE}(\text{sat})$	$I_C=5\text{A}, I_B=1\text{A}$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5\text{mA}, I_E=0$	1500			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=100\text{mA}, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=200\text{mA}, I_C=0$	7			V
Diode Forward Voltage	V_F	$I_{EC}=6\text{A}$			2	V
Fall Time	t_f	$I_C=5\text{A}, I_{B1}=1\text{A}, I_{B2}=-2\text{A}$ $V_{CC}=200\text{V}, R_L=40\text{ohm}$			0.7	μs

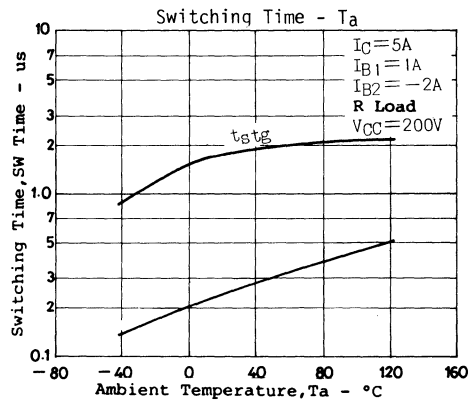
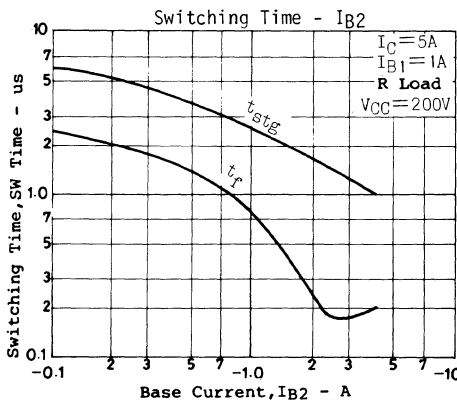
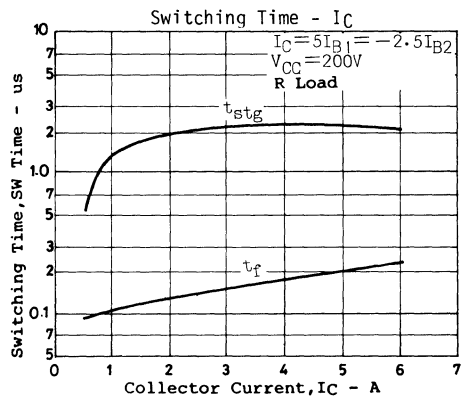
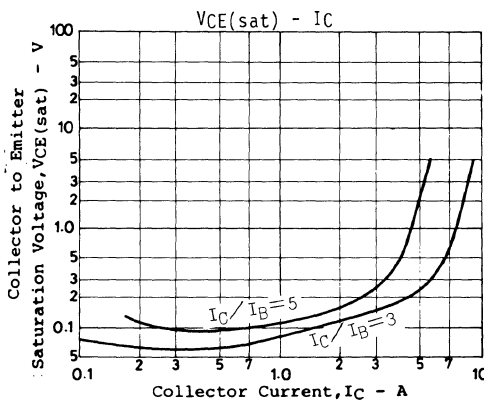
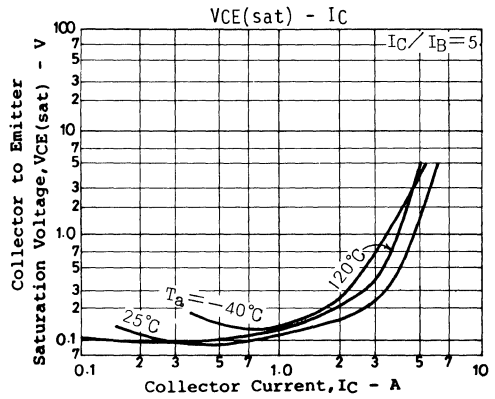
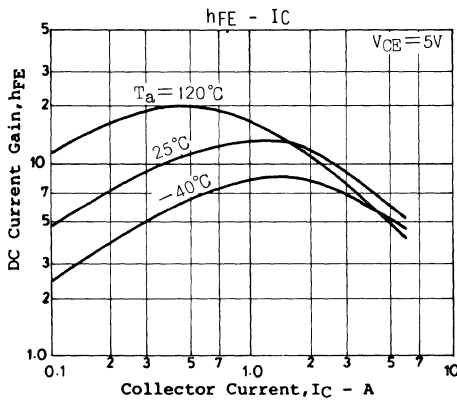
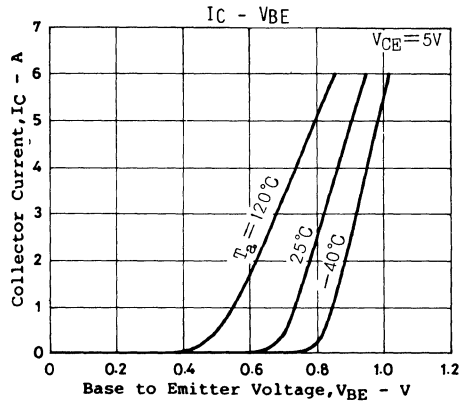
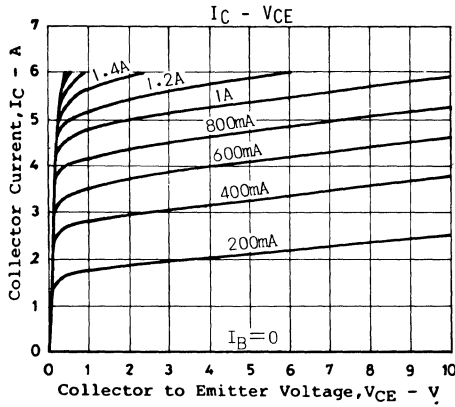
Switching Time Test Circuit

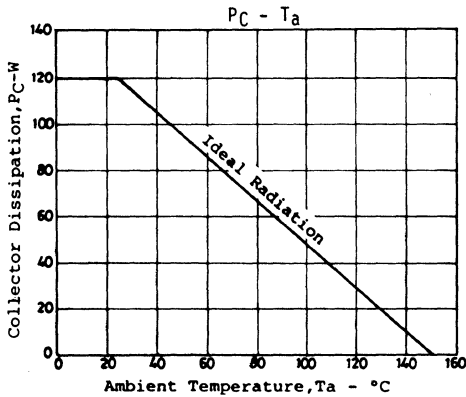
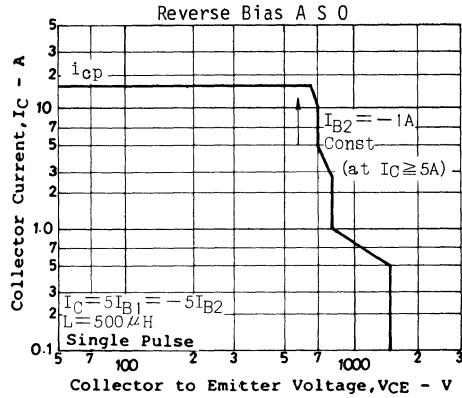
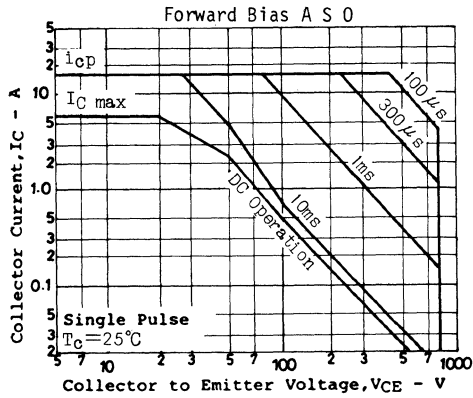


Case Outline 2022

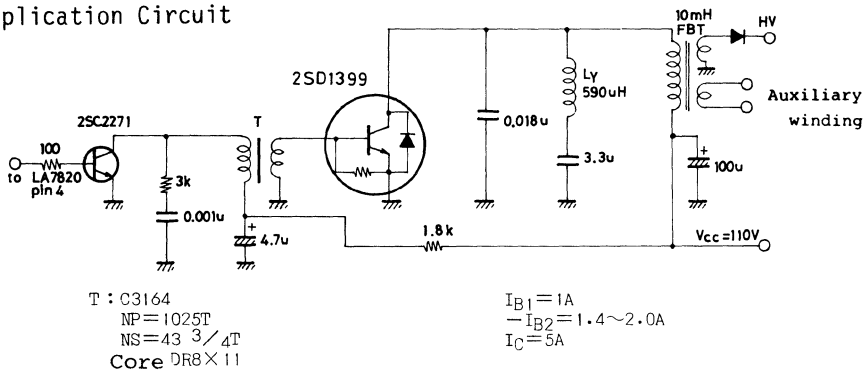
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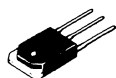




Sample Application Circuit



2SD1400



2022

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications

©1267

Features:

- High breakdown voltage and high reliability
- High switching speed
- Capable of being mounted easily due to one-point fixing type plastic mold package

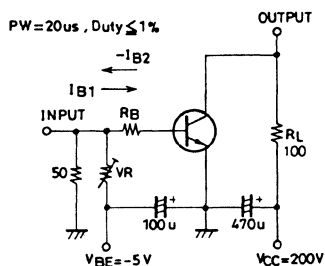
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	1500	V
Collector to Emitter Voltage	V_{CE0}	800	V
Emitter to Base Voltage	V_{EB0}	7	V
Collector Current	I_C	2.5	A
Peak Collector Current	i_{cp}	10	A
Collector Dissipation	P_C	80	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

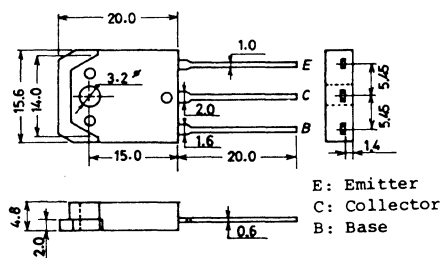
Electrical Characteristics at $T_a=25^\circ\text{C}$

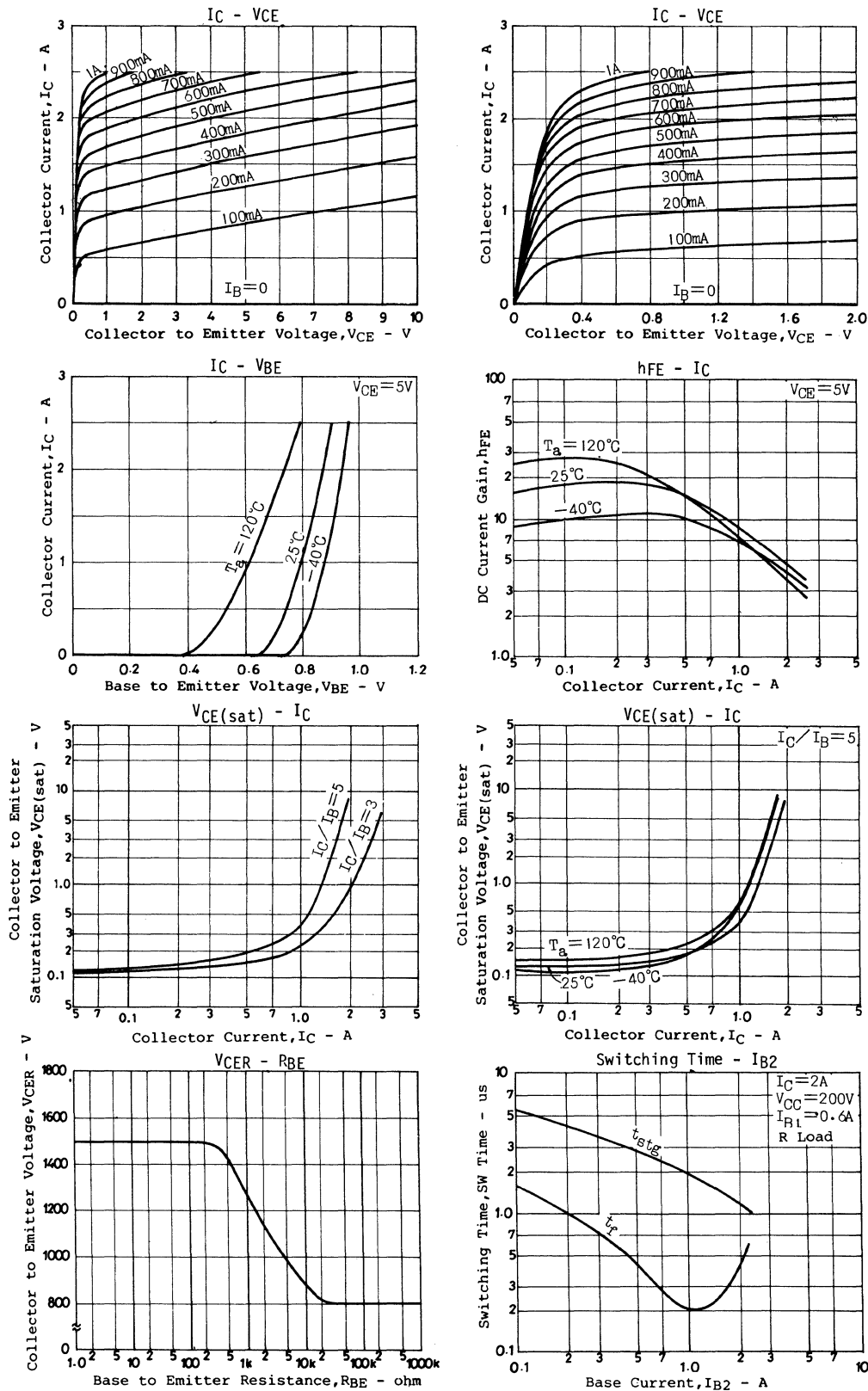
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800\text{V}, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5\text{V}, I_C=0$			1	mA
DC Current Gain	h_{FE}	$V_{CE}=5\text{V}, I_C=0.5\text{A}$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=0.5\text{A}$		3		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=2\text{A}, I_B=0.6\text{A}$			8	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=2\text{A}, I_B=0.6\text{A}$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5\text{mA}, I_E=0$	1500			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=100\text{mA}, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=200\text{mA}, I_C=0$	7			V
Fall Time	t_f	$I_C=2\text{A}, I_{B1}=0.6\text{A}, I_{B2}=-1.2\text{A}$			0.7	μs

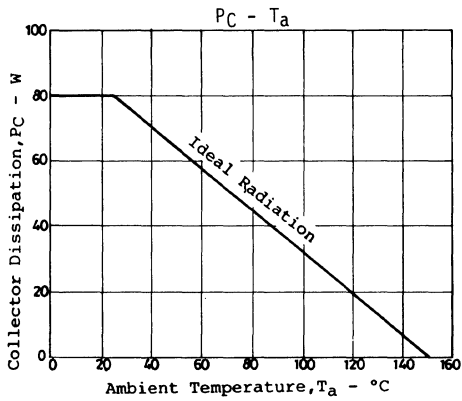
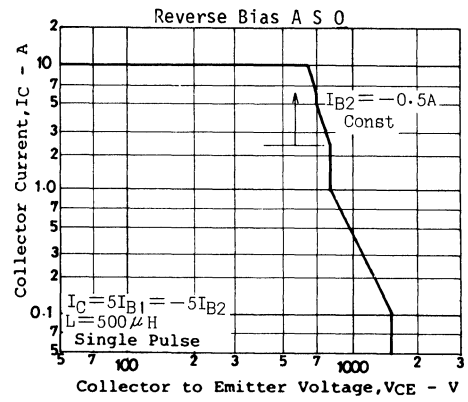
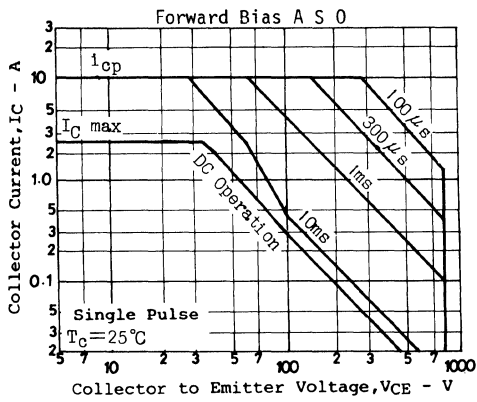
Switching Time Test Circuit



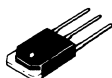
Case Outline 2022 (unit:mm)







2SD1401



2022

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications

©1268

Features:

- High breakdown voltage and high reliability
- High switching speed
- Capable of being mounted easily due to one-point fixing type plastic mold package

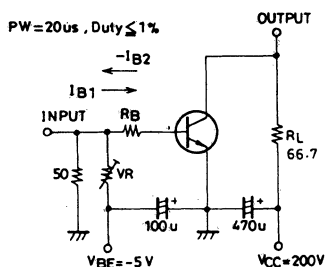
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_C	3.5	A
Peak Collector Current	i_{cp}	10	A
Collector Dissipation	P_C	80	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

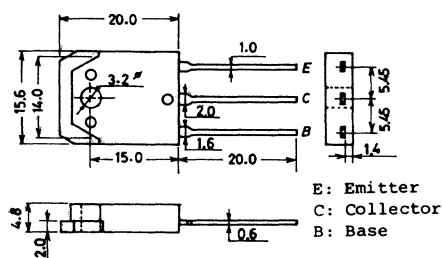
Electrical Characteristics at $T_a=25^\circ\text{C}$

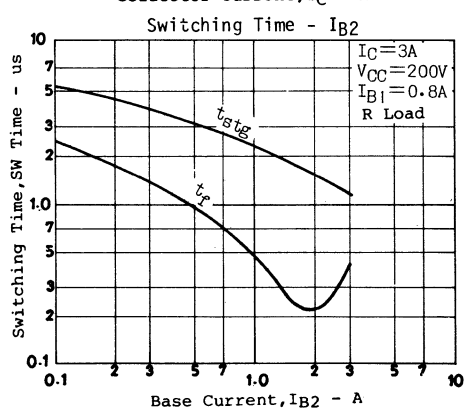
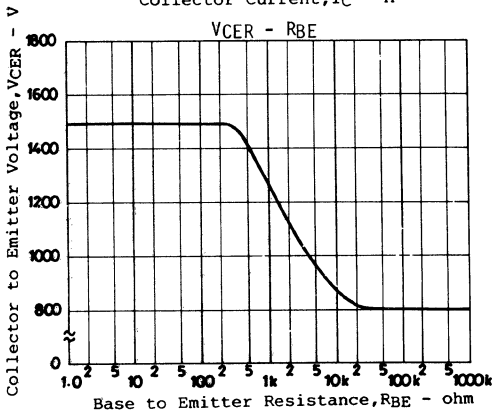
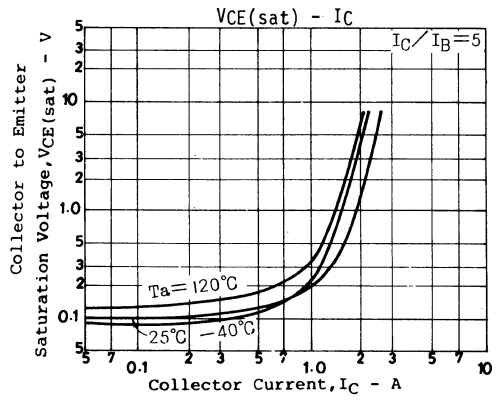
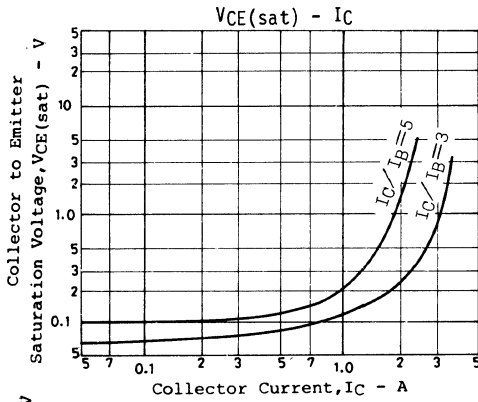
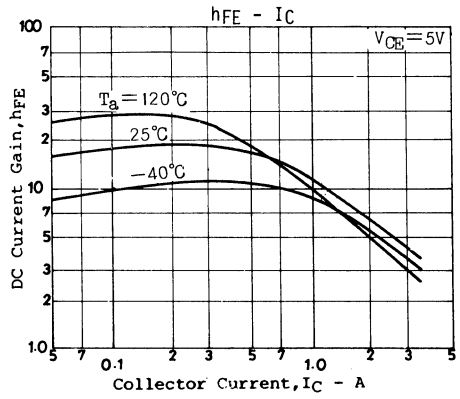
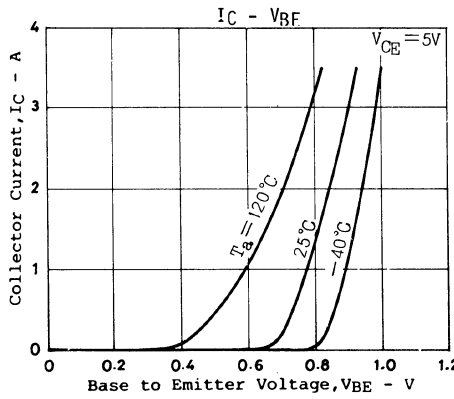
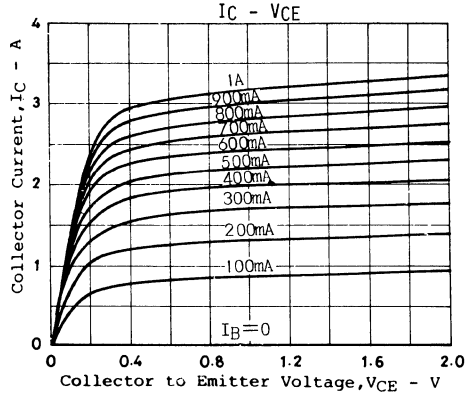
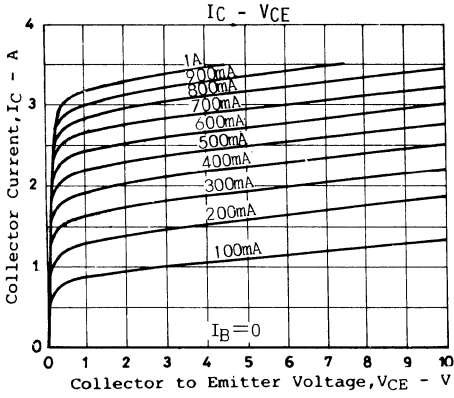
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800\text{V}, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5\text{V}, I_C=0$			1	mA
DC Current Gain	h_{FE}	$V_{CE}=5\text{V}, I_C=0.5\text{A}$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=0.5\text{A}$		3		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=2.5\text{A}, I_B=0.8\text{A}$			8	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=2.5\text{A}, I_B=0.8\text{A}$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5\text{mA}, I_E=0$	1500			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=100\text{mA}, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=200\text{mA}, I_C=0$	7			V
Fall Time	t_f	$I_C=3\text{A}, I_{B1}=0.8\text{A}, I_{B2}=-1.6\text{A}$			0.7	μs

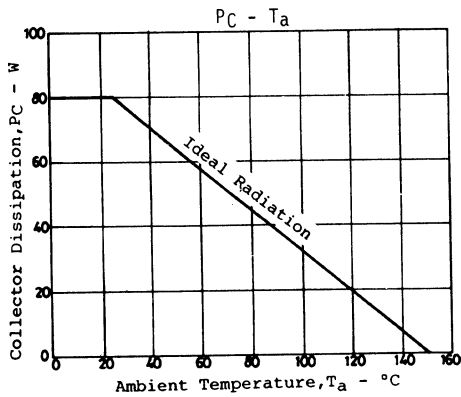
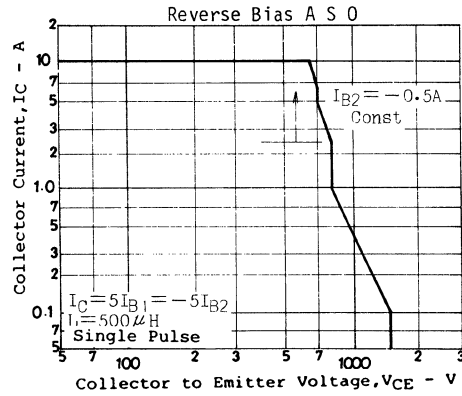
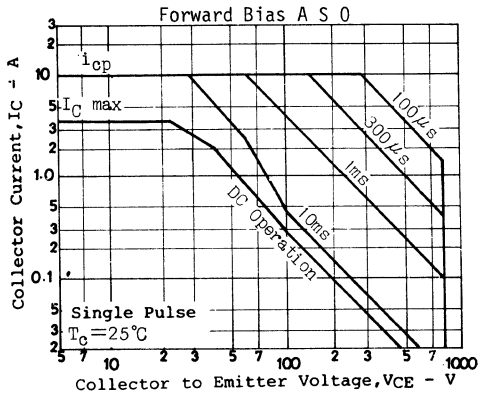
Switching Time Test Circuit



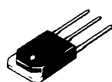
Case Outline 2022 (unit:mm)







2SD1402



2022

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications

©1269

Features:

- High breakdown voltage and high reliability
- High switching speed
- Capable of being mounted easily due to one-point fixing type plastic mold package

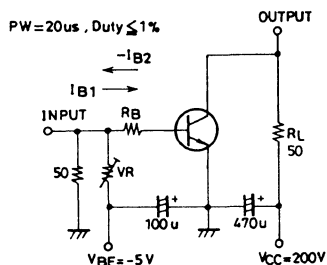
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_C	5	A
Peak Collector Current	i_{cp}	16	A
Collector Dissipation	P_C	120	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

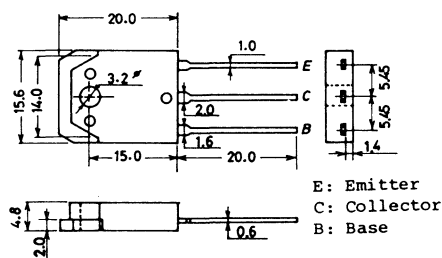
Electrical Characteristics at $T_a=25^\circ\text{C}$

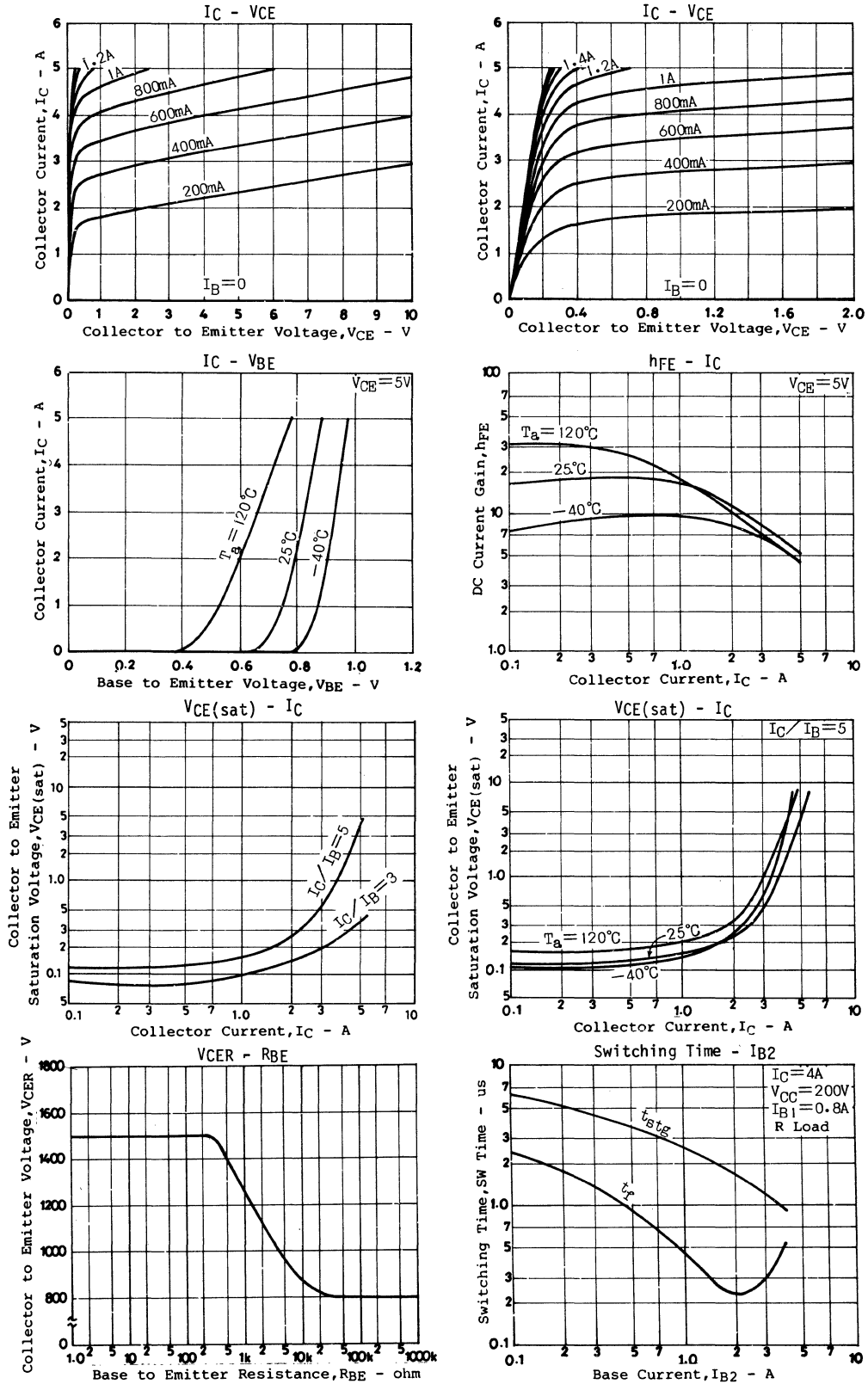
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800\text{V}, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5\text{V}, I_C=0$			1	mA
DC Current gain	h_{FE}	$V_{CE}=5\text{V}, I_C=1\text{A}$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=1\text{A}$		3		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=4\text{A}, I_B=0.8\text{A}$			5	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=4\text{A}, I_B=0.8\text{A}$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5\text{mA}, I_E=0$	1500			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=100\text{mA}, R_{BE}=\infty$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=200\text{mA}, I_C=0$	7			V
Fall Time	t_f	$I_C=4\text{A}, I_{B1}=0.8\text{A}, I_{B2}=-1.6\text{A}$			0.7	μs

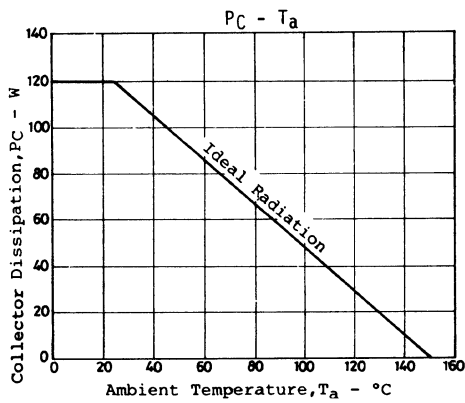
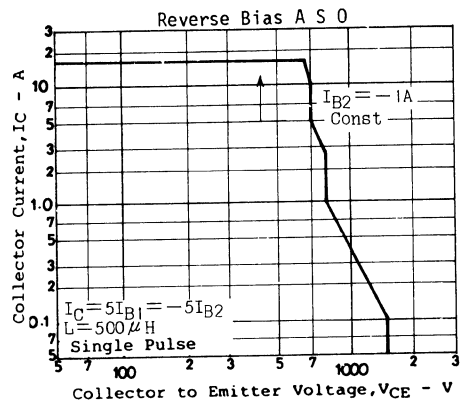
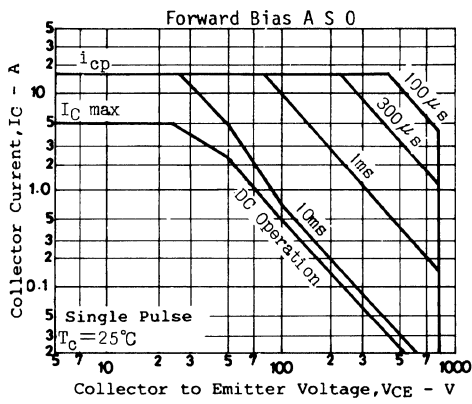
Switching Time Test Circuit



Case Outline 2022 (unit:mm)







2SD1403



2022

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications

©1270

Features:

- High breakdown voltage and high reliability
- High switching speed
- Capable of being mounted easily due to one-point fixing type plastic mold package

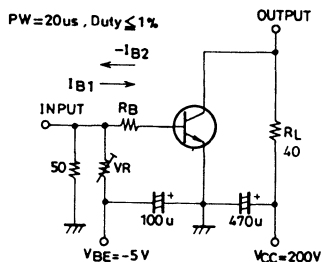
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	7	V
Collector Current	I_C	6	A
Peak Collector Current	i_{cp}	16	A
Collector Dissipation	P_C	120	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

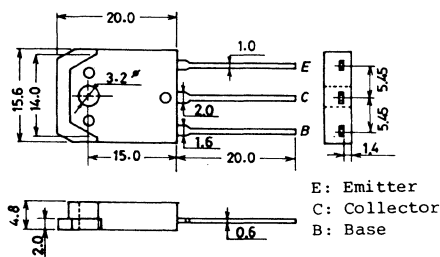
Electrical Characteristics at $T_a=25^\circ\text{C}$

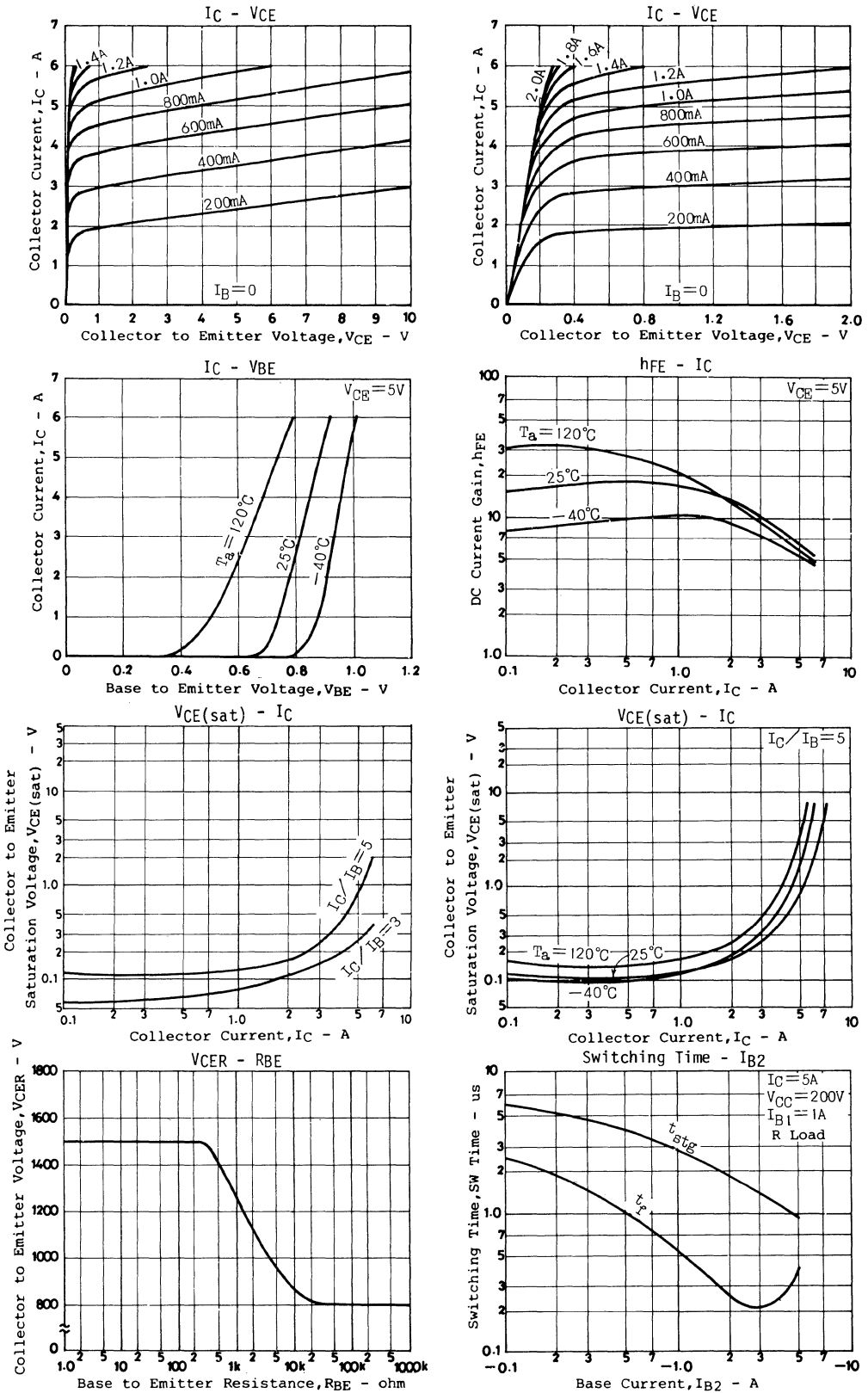
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800\text{V}, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5\text{V}, I_C=0$			1	mA
DC Current Gain	h_{FE}	$V_{CE}=5\text{V}, I_C=1\text{A}$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=1\text{A}$		3		MHz
C-E Saturation Voltage	$V_{CE}(\text{sat})$	$I_C=5\text{A}, I_B=1\text{A}$			5	V
B-E Saturation Voltage	$V_{BE}(\text{sat})$	$I_C=5\text{A}, I_B=1\text{A}$			1.5	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5\text{mA}, I_E=0$	1500			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=100\text{mA}, R_{BE}=00$	800			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=200\text{mA}, I_C=0$	7			V
Fall Time	t_f	$I_C=5\text{A}, I_{B1}=1\text{A}, I_{B2}=-2\text{A}$			0.7	μs

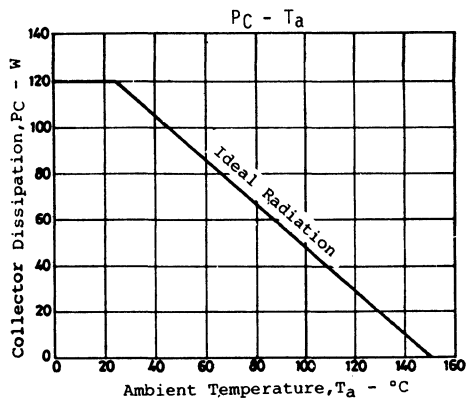
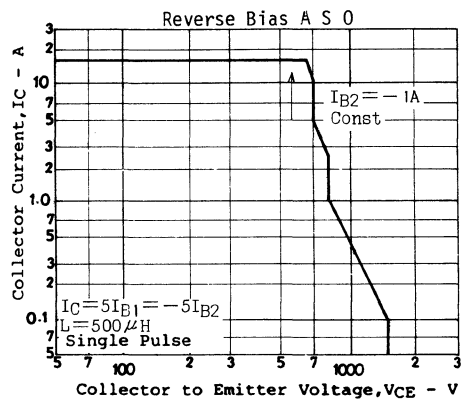
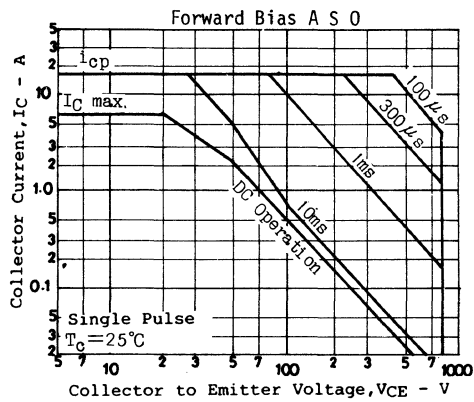
Switching Time Test Circuit



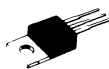
Case Outline 2022 (unit:mm)







2SD1459



2010A

NPN/PNP Planar
Silicon Transistors

2SB1037

Color TV Vertical Output, Sound Output Applications

©1256

Features

- High allowable collector dissipation ($P_C = 2W$)
- WIDE ASO

(): 2SB1037

Absolute Maximum Ratings/ $T_a = 25^\circ C$

			unit
Collector to base voltage	V_{CBO}	(-)150	V
Collector to emitter voltage	V_{CEO}	(-)150	V
Emitter to base voltage	V_{EBO}	(-)5	V
Collector current	I_C	(-)1.5	A
Peak collector current	i_{cp}	(-)3	A
Collector dissipation	P_C	2.0	W
		30	W
Junction temperature	T_j	175	$^\circ C$
Storage temperature	T_{stg}	-55 ~ +175	$^\circ C$

$T_c = 25^\circ C$

Electrical Characteristics/ $T_a = 25^\circ C$

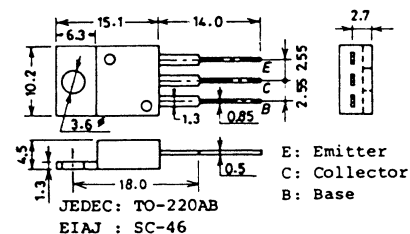
			min	typ	max	unit
Collector cutoff current	I_{CBO}	$V_{CB} = (-)120 V$			(-)10	μA
Emitter cutoff current	I_{EBO}	$V_{EB} = (-)5 V$			(-)10	μA
DC current gain	h_{FE}	$V_{CE} = (-)5 V, I_C = (-)0.3 A$	70*		200*	
Gain bandwidth product	f_T	$V_{CE} = (-)5 V, I_C = (-)100 mA$		(15)8		MHz
C-E saturation voltage	$V_{CE(sat)}$	$I_C = (-)500 mA, I_B = (-)50 mA$			(-)1.5	V
B-E saturation voltage	$V_{BE(sat)}$	$I_C = (-)500 mA, I_B = (-)50 mA$			(-)1.2	V

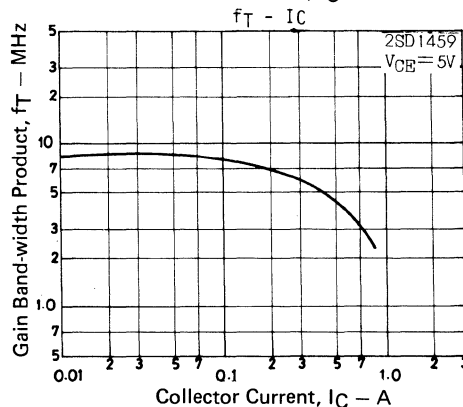
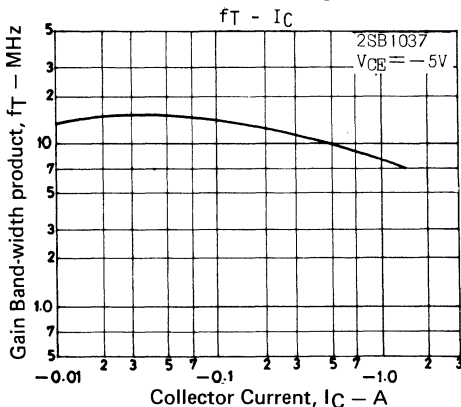
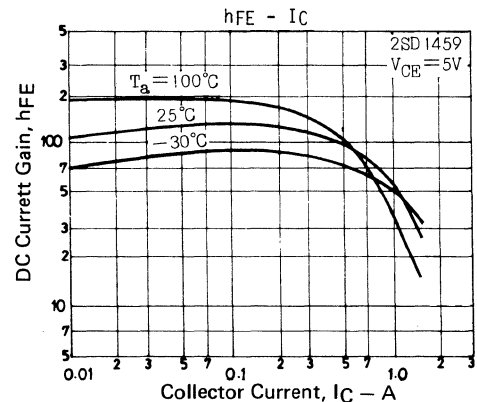
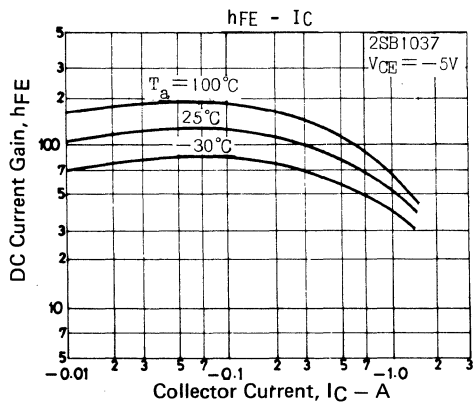
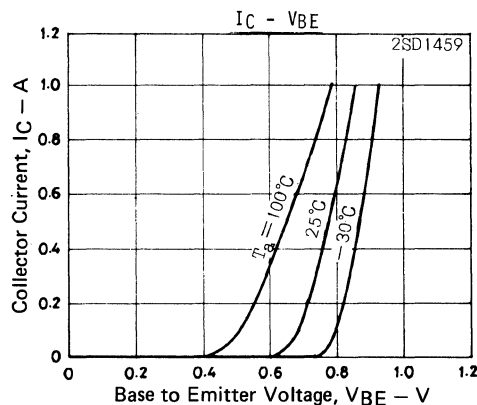
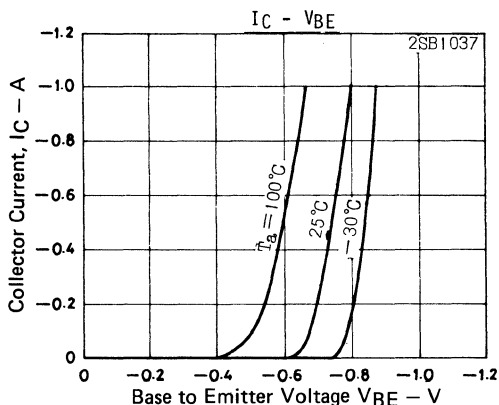
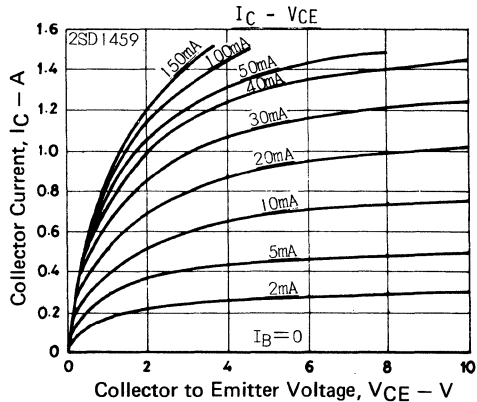
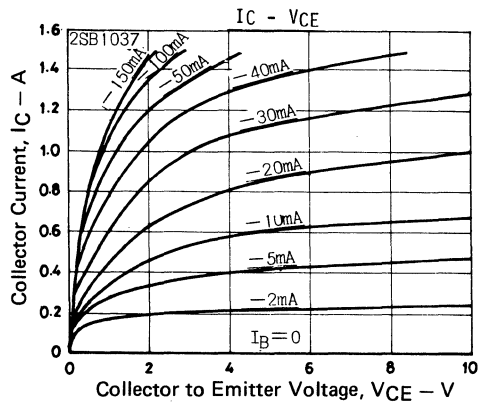
* The 2SB1037/2SD1459 are classified by 0.3A h_{FE} as follows:

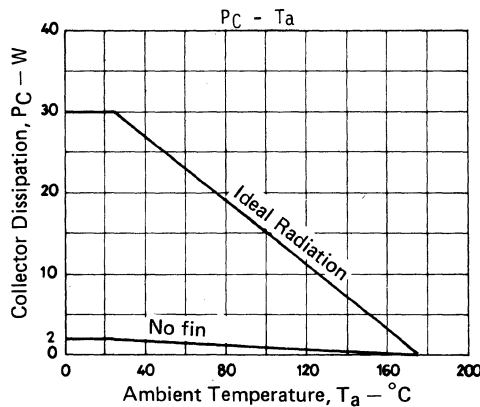
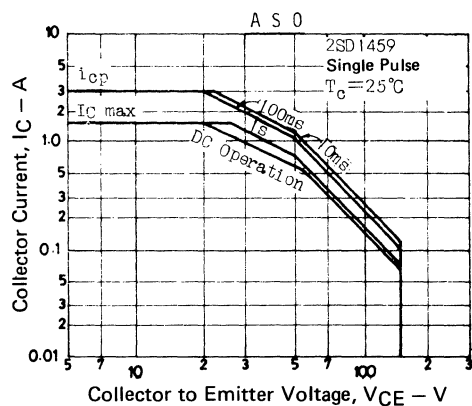
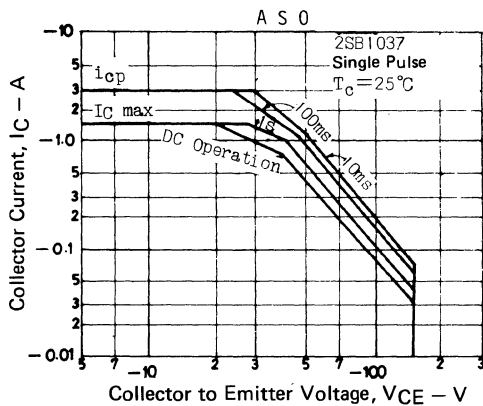
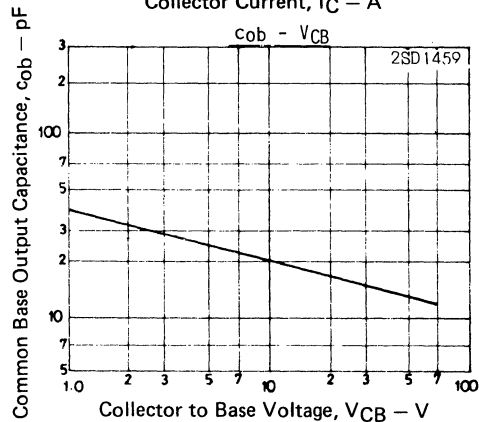
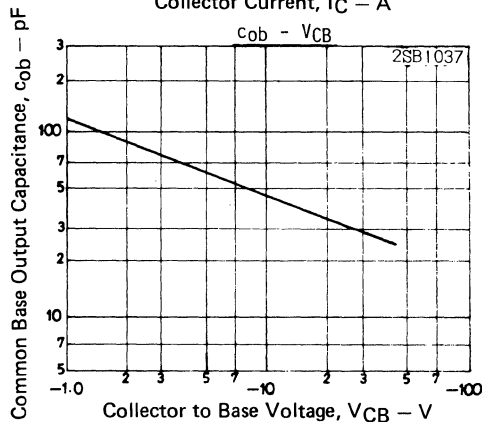
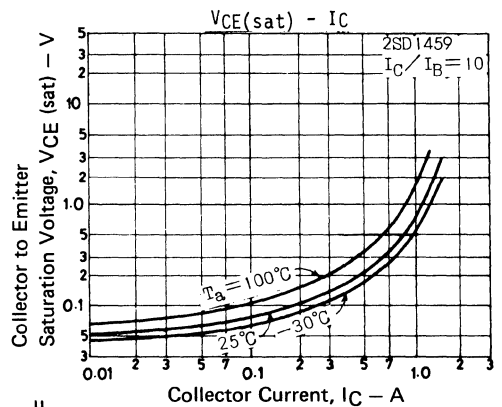
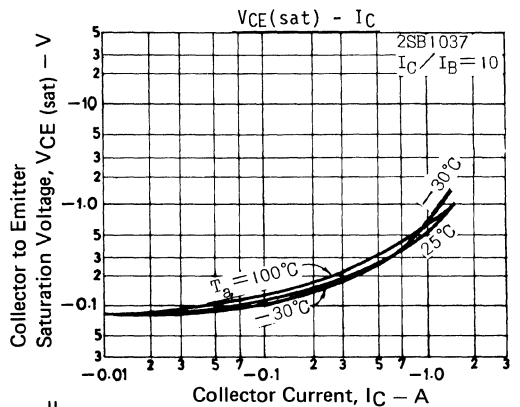
70	Q	140	100	R	200
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Case Outline 2010A

(unit: mm)







2SD1618



2038

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB1118

Low Voltage, High Current Amp, Muting Applications

©1784

Features

- Low collector-to-emitter saturation voltage.
- Very small size making it easy to provide high-density, small-sized hybrid IC's

(): 2SB1118

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)20	V
Collector to Emitter Voltage	V_{CEO}	(-)15	V
Emitter to Base Voltage	V_{EBO}	(-)5	V
Collector Current	I_C	(-)0.7	A
Peak Collector Current	i_{cp}	(-)1.5	A
Collector Dissipation	P_C	500	mW
	P_C Mounted on ceramic board (250mm ² x 0.8mm)	1.3	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=(-)15\text{V}, I_C=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	μA
DC Current Gain	$h_{FE(1)}$	$V_{CE}=(-)2\text{V}, I_C=(-)50\text{mA}$	140		800	
	$h_{FE(2)}$	$V_{CE}=(-)2\text{V}, I_C=(-)500\text{mA}$	60			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		250		MHz
C-E Saturation Voltage	$V_{CE(sat)1}$	$I_C=(-)5\text{mA}, I_B=(-)0.5\text{mA}$		10	25	mV
				(-15)	(-35)	mV
	$V_{CE(sat)2}$	$I_C=(-)100\text{mA}, I_B=(-)10\text{mA}$		30	80	mV
				(-60)	(-120)	mV
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)100\text{mA}, I_B=(-)10\text{mA}$		(-)0.8	(-)1.2	V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10\mu\text{A}$		(-)20		V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1\text{mA}$		(-)15		V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10\mu\text{A}$		(-)5		V
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$		8		pF
				(13)		pF

* The 2SB1118/2SD1618 are classified by 50mA h_{FE} as follows:

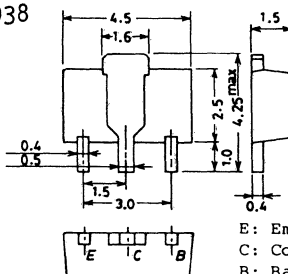
140	S	280	200	E	400	280	U	560
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Case Outline 2038 (unit:mm)

Marking

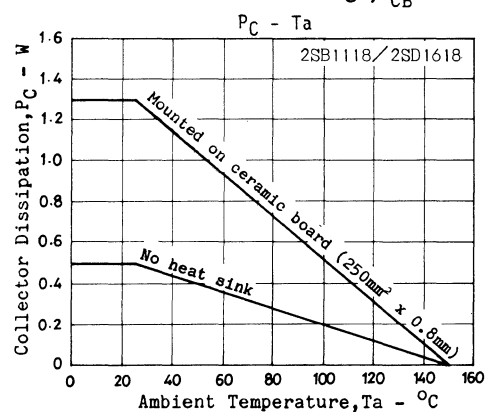
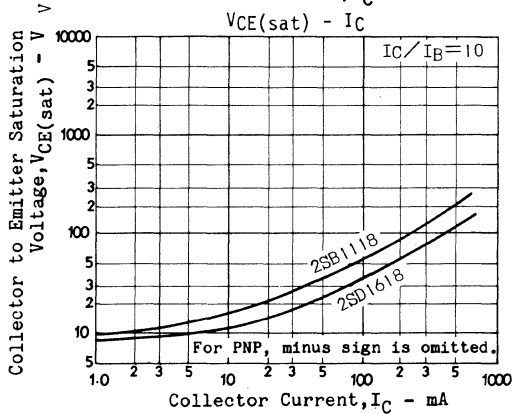
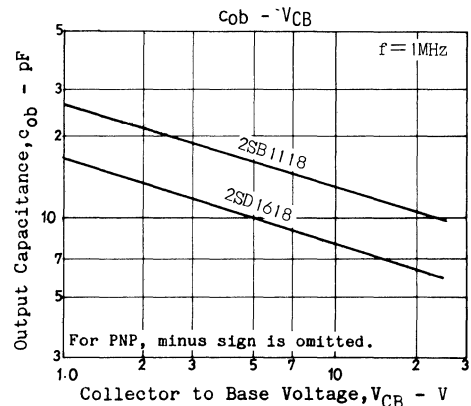
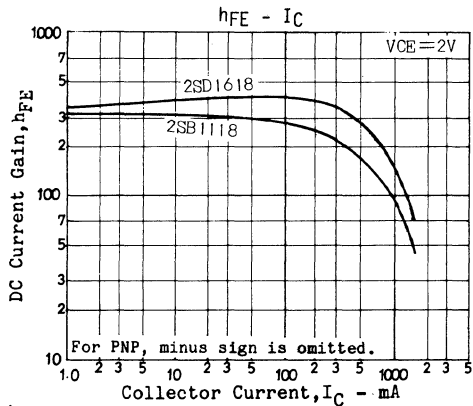
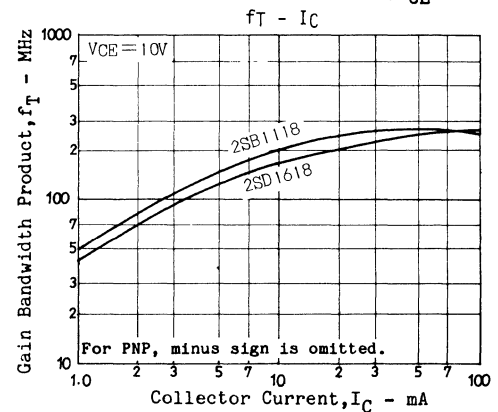
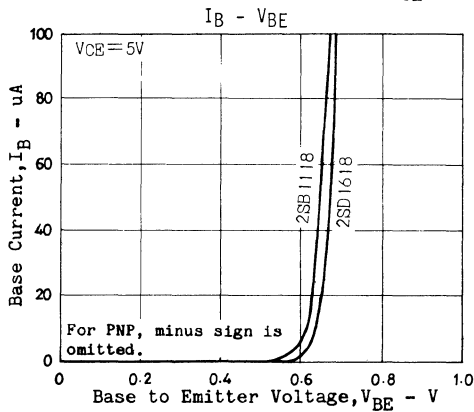
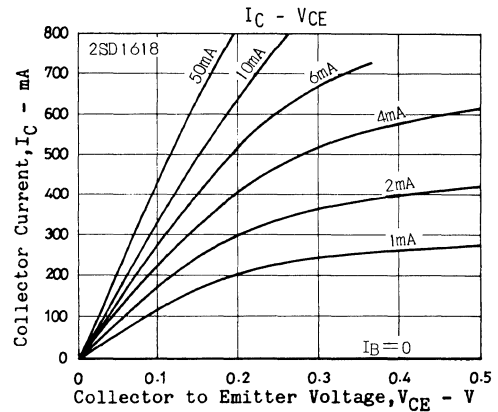
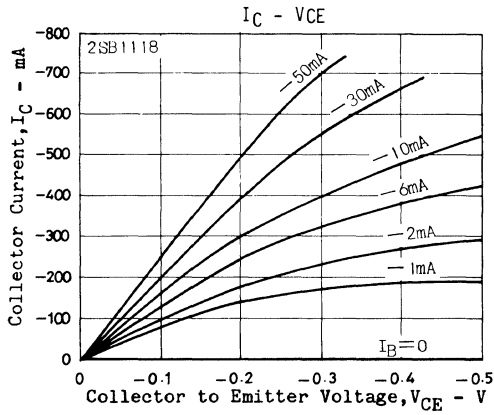
2SB1118.....BA

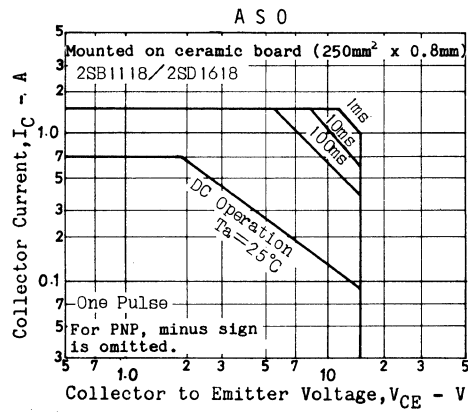
2SD1618.....DA



E: Emitter
C: Collector
B: Base

SANYO: PCP





2SD1619



2038

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB1119

Low Frequency Amp, Electronic Governor Applications

©1785

Features

Very small size making it easy to provide high-density, small-sized hybrid IC's

(): 2SB1119

Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CB0}	(-)25	V
Collector to Emitter Voltage	V_{CE0}	(-)25	V
Emitter to Base Voltage	V_{EEO}	(-)5	V
Collector Current	I_C	(-)1	A
Peak Collector Current	i_{cp}	(-)2	A
Collector Dissipation	P_C	500	mW
	P_C Mounted on ceramic board (250mm ² x 0.8mm)	1.3	W
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

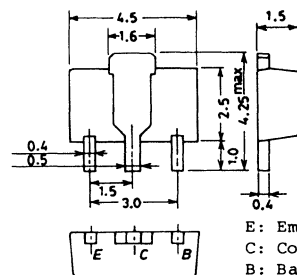
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)20V, I_E=0$			(-)0.1	uA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)4V, I_C=0$			(-)0.1	uA
DC Current Gain	$h_{FE}(1)^*$	$V_{CE}=(-)2V, I_C=(-)50mA$	100		560	
	$h_{FE}(2)$	$V_{CE}=(-)2V, I_C=(-)1A$	40			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		180		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500mA, I_B=(-)50mA$		0.1	0.3	V
				(-0.15)	(-0.7)	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500mA, I_B=(-)50mA$		(-)0.85	(-)1.2	V
C-B Breakdown Voltage	$V_{(BR)CB0}$	$I_C=(-)10uA, I_E=0$	(-)25			V
C-E Breakdown Voltage	$V_{(BR)CE0}$	$I_C=(-)1mA, R_{BE}=\infty$	(-)25			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10uA, I_C=0$	(-)5			V
Output Capacitance	c_{ob}	$V_{CE}=(-)10V, f=1MHz$		15		pF
				(25)		pF

* The 2SB1119/2SD1619 are classified by 50mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400	280	U	560
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Case Outline 2038 (unit:mm)



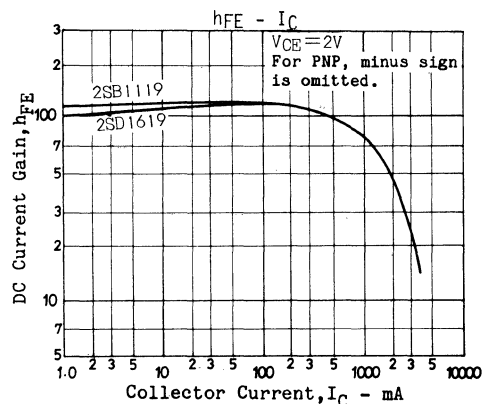
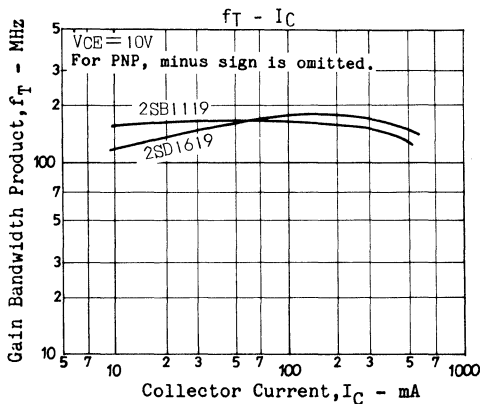
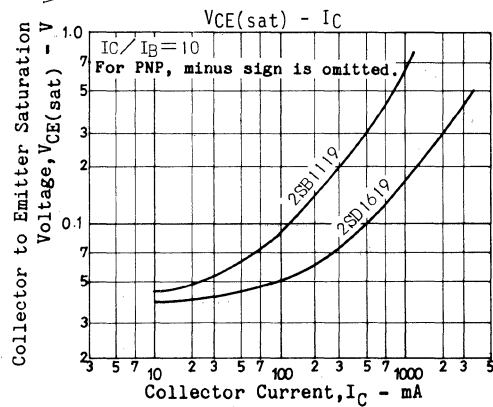
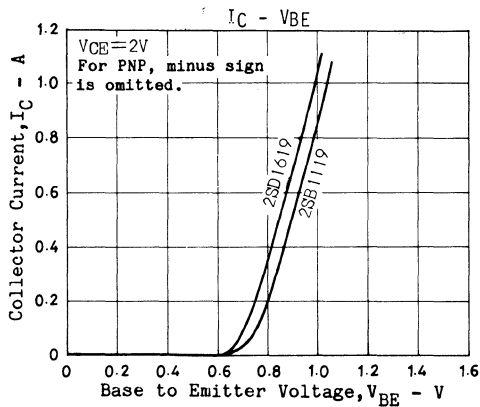
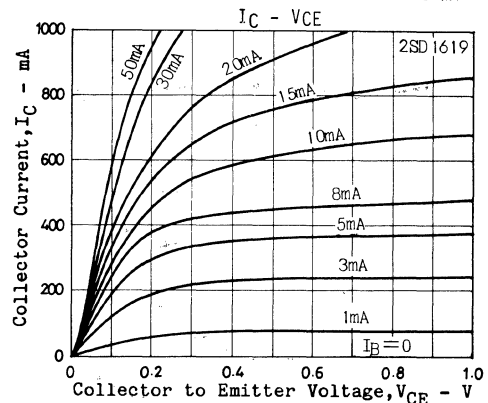
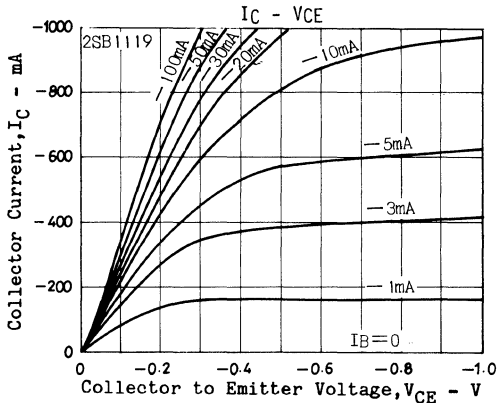
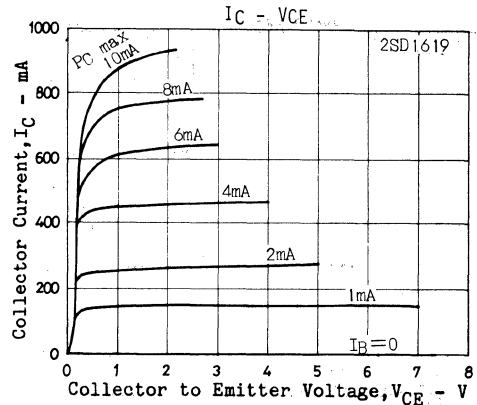
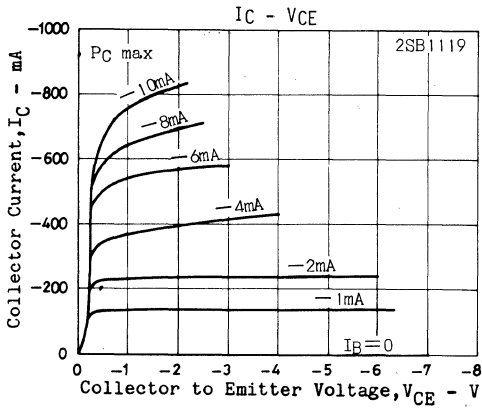
Marking

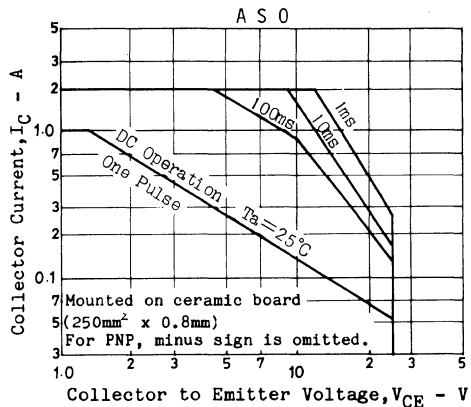
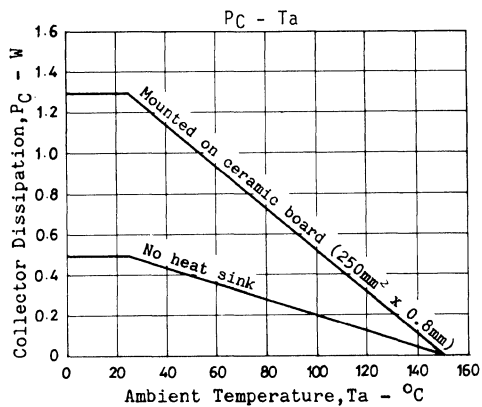
2SB1119.....BB

2SD1619.....DB

E: Emitter
C: Collector
B: Base

SANYO: PCP





2SD1620



2038

NPN Epitaxial Planar
Silicon Transistor

1.5V, 3V Strobe Applications

©1719

Features

- . Less power dissipation because of low $V_{CE(sat)}$, permitting more flashes of light to be emitted.
- . Large current capacity and highly resistant to breakdown.
- . Excellent linearity of h_{FE} from low current to high current.
- . Very small size making it easy to provide high-density, small-sized hybrid IC's.

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

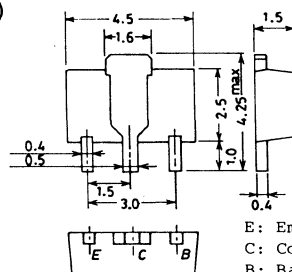
			unit
Collector to Base Voltage	V_{CBO}	30	V
Collector to Emitter Voltage	V_{CEX}	20	V
Collector to Emitter Voltage	V_{CEO}	10	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	3	A
Peak Collector Current	i_{cp}	5	A
Collector Dissipation	$P_C(1)$	500	mW
	$P_C(2)$ Mounted on ceramic board (250mm ² x 0.8mm)	1.3	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

		min	typ	max	unit
Collector Cutoff Current	I_{CBO} $V_{CB}=20\text{V}, I_E=0$			100	nA
Emitter Cutoff Current	I_{EBO} $V_{EB}=4\text{V}, I_C=0$			100	nA
DC Current Gain	h_{FE} $V_{CE}=2\text{V}, I_C=3\text{A}$	140	210		
Gain Bandwidth Product	f_T $V_{CE}=10\text{V}, I_C=50\text{mA}$		200		MHz
Output Capacitance	c_{ob} $V_{CB}=10\text{V}, f=1\text{MHz}$		30		pF
C-E Saturation Voltage	$V_{CE(sat)}$ $I_C=3\text{A}, I_B=60\text{mA}$		0.3	0.4	V
C-B Breakdown Voltage	$V_{(BR)CBO}$ $I_C=10\mu\text{A}, I_E=0$	30			V
C-E Breakdown Voltage	$V_{(BR)CEX}$ $I_C=1\text{mA}, V_{BE}=3\text{V}$	20			V
C-E Breakdown Voltage	$V_{(BR)CEO}$ $I_C=1\text{mA}, R_{BE}=\infty$	10			V
E-B Breakdown Voltage	$V_{(BR)EBO}$ $I_E=10\mu\text{A}, I_C=0$	6			V

Case Outline 2038 (unit:mm)

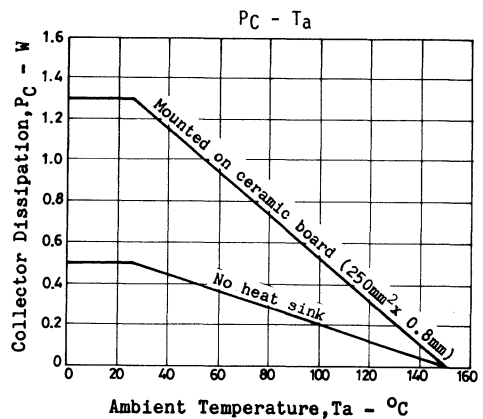
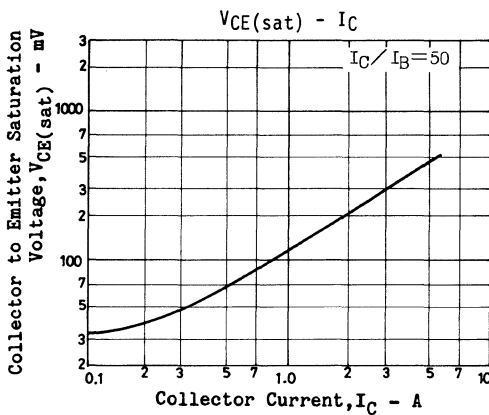
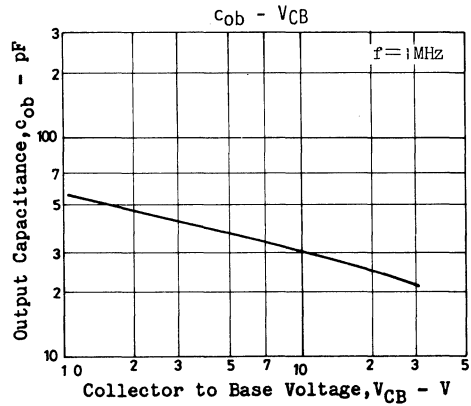
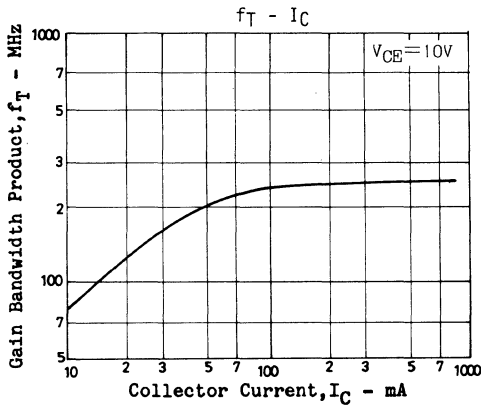
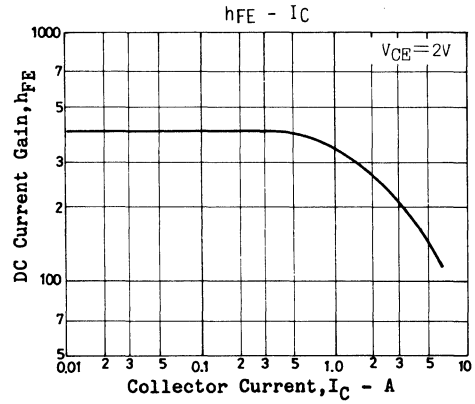
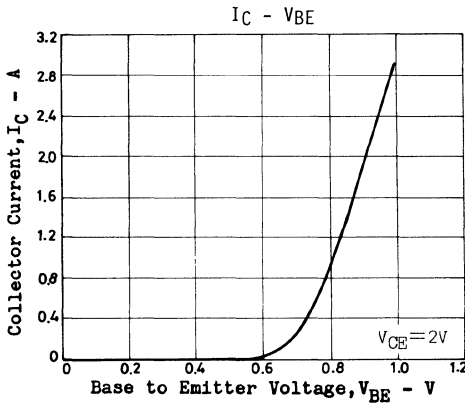
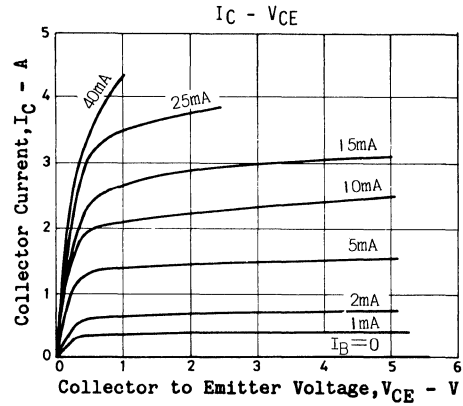
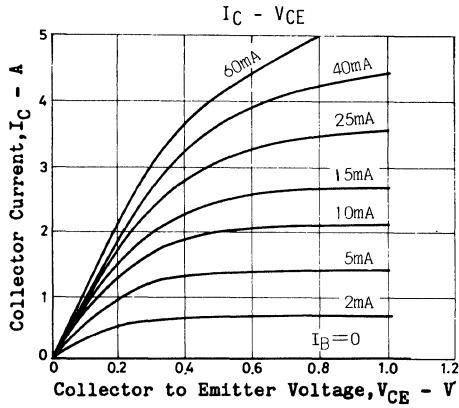
[Marking: DC]

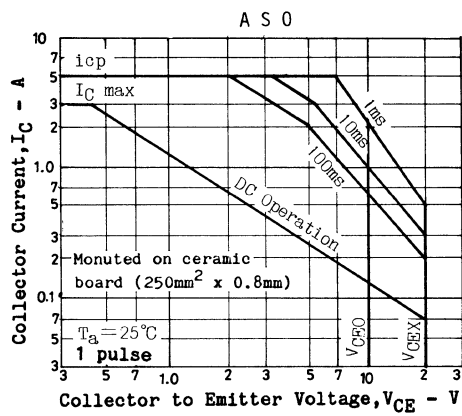


E: Emitter
C: Collector
B: Base

SANYO: PCP

3045MY, TS No.1719-1/3





2SD1621



2038

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB1121

High Current Driver Applications

©1787

Applications

- . Voltage regulators, relay drivers, lamp drivers, electrical equipment.

Features

- . Adoption of FBET, MBIT processes.
- . Low collector-to-emitter saturation voltage.
- . Large current capacity and wide ASO.
- . Fast switching speed.
- . Very small size making it easy to provide high-density, small-sized hybrid IC's.

(): 2SB1121

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)30	V
Collector to Emitter Voltage	V_{CE0}	(-)25	V
Emitter to Base Voltage	V_{EB0}	(-)6	V
Collector Current	I_C	(-)2	A
Peak Collector Current	i_{cp}	(-)5	A
Collector Dissipation	P_C	500	mW
	P_C	Mounted on ceramic board (250mm ² x 0.8mm)	1.3 W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

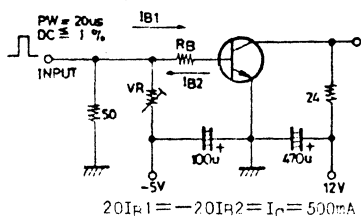
			min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)20\text{V}, I_E=0$			(-)0.1	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)4\text{V}, I_C=0$			(-)0.1	μA
DC Current Gain	$h_{FE(1)}$ *	$V_{CE}=(-)2\text{V}, I_C=(-)100\text{mA}$	100		560	
	$h_{FE(2)}$	$V_{CE}=(-)2\text{V}, I_C=(-)1.5\text{A}$	65			
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		150		MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)1.5\text{A}, I_B=(-)75\text{mA}$		0.18	0.4	V
				(-0.35)	(-0.6)	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)1.5\text{A}, I_B=(-)75\text{mA}$		(-)0.85	(-)1.2	V

* The 2SB1121/2SD1621 are classified by 100mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400	280	U	560
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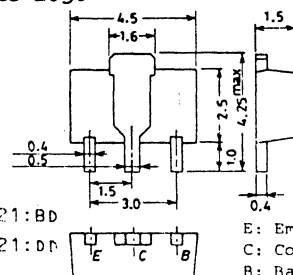
Switching Time Test Circuit

(For PNP, polarity is reversed.)



Case Outline 2038

(unit:mm)

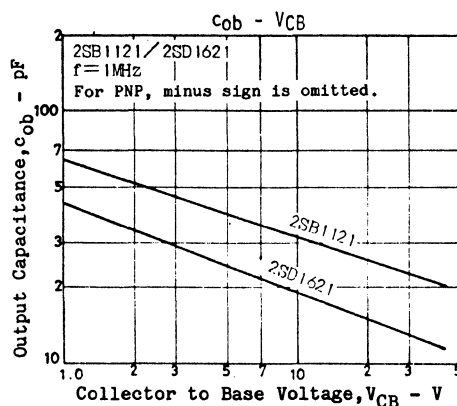
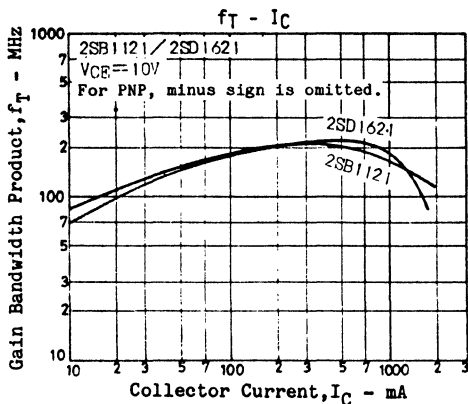
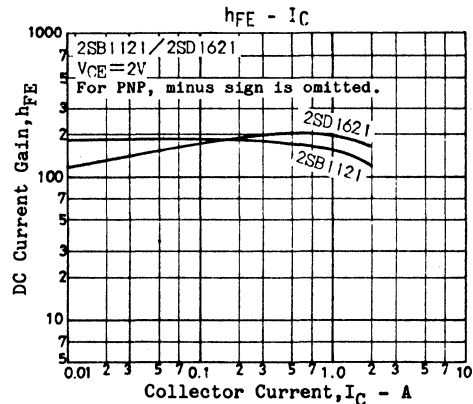
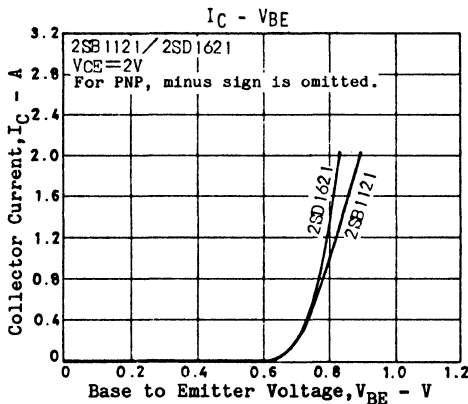
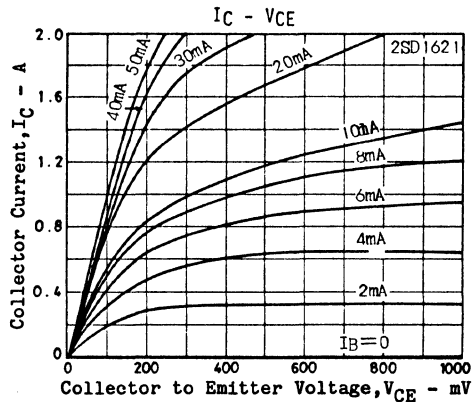
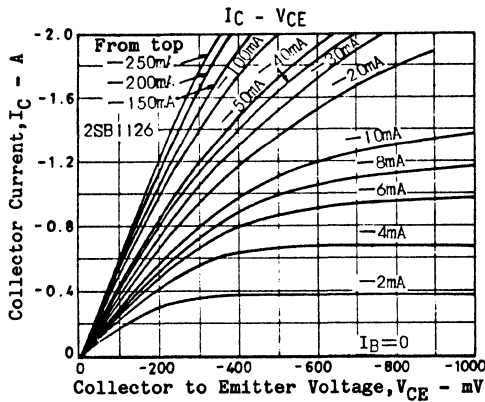


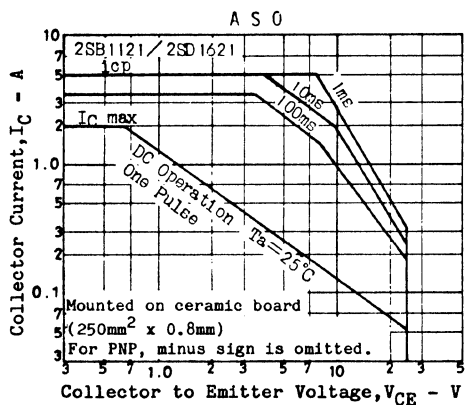
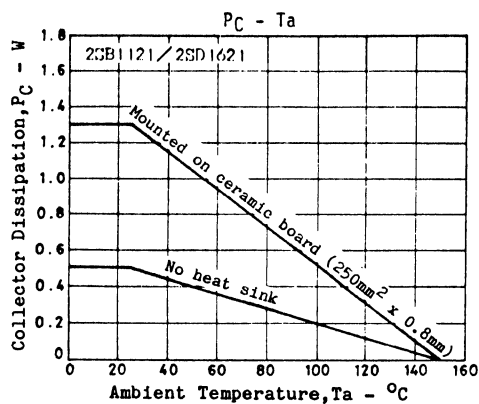
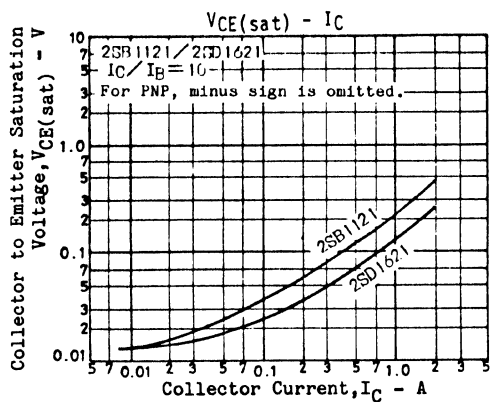
Marking 2SB1121:BD
2SD1621:DP

E: Emitter
C: Collector
B: Base

SANYO: PCP

			min	typ	max	unit
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C = (-)10\mu A, I_E = 0$	(-)30			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C = (-)1mA, R_{BE} = \infty$	(-)25			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E = (-)10\mu A, I_C = 0$	(-)6			V
Output Capacitance	c_{ob}	$V_{CB} = (-)10V, f = 1MHz$		19		pF
				(32)		pF
Turn-ON Time	t_{on}	at Test Circuit		60		ns
				(60)		ns
Storage Time	t_{stg}	"		500		ns
				(350)		ns
Fall Time	t_f	"		25		ns
				(25)		ns





2SD1623



2038

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB1123

High Current Switching Applications

©1727

Applications

- . Voltage regulators, relay drivers, lamp drivers, electrical equipment.

Features

- . Adoption of FBET, MBIT processes.
- . Low collector-to-emitter saturation voltage.
- . Large current capacity and wide ASO.
- . Fast switching speed.
- . Very small size making it easy to provide high-density, small-sized hybrid IC's.

(): 2SB1123

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	(-)60	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)6	V
Collector Current	I_C	(-)2	A
Peak Collector Current	i_{cp}	(-)4	A
Collector Dissipation	P_C	500	mW
	P_C^*	1.3	W
Junction Temperature	T_J	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

* Mounted on ceramic board (250mm² x 0.8mm)

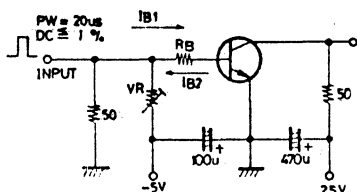
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

		min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)50\text{V}, I_E=0$		(-)100	nA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)4\text{V}, I_C=0$		(-)100	nA
DC Current Gain	h_{FE1}^{**}	$V_{CE}=(-)2\text{V}, I_C=(-)100\text{mA}$	100	560	
	h_{FE2}	$V_{CE}=(-)2\text{V}, I_C=(-)1.5\text{A}$	40		
Gain Bandwidth Product	f_T	$V_{CE}=(-)10\text{V}, I_C=(-)50\text{mA}$		150	MHz
Output Capacitance	c_{ob}	$V_{CB}=(-)10\text{V}, f=1\text{MHz}$	(22)12		pF

* The 2SB1123/2SD1623 are classified by 100mA h_{FE} as follows:

100	R	200	140	S	280	200	T	400	280	U	560
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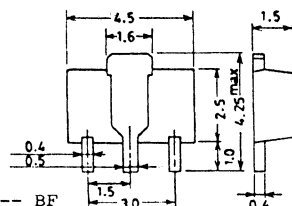
Switching Time Test Circuit



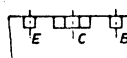
$20I_{B1} = -20I_{B2} = I_C = 500\text{mA}$
(For PNP, polarity is reversed.)

Case Outline 2038

(unit:mm)



Marking: 2SB1123 -- BF
2SD1623 -- DF

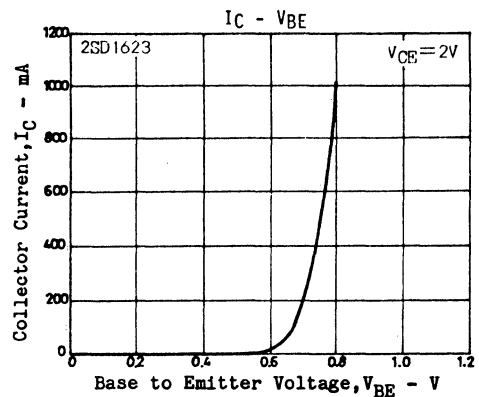
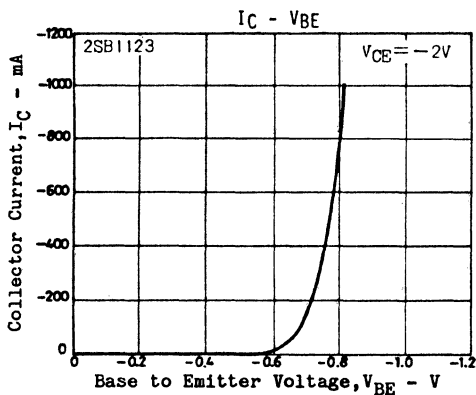
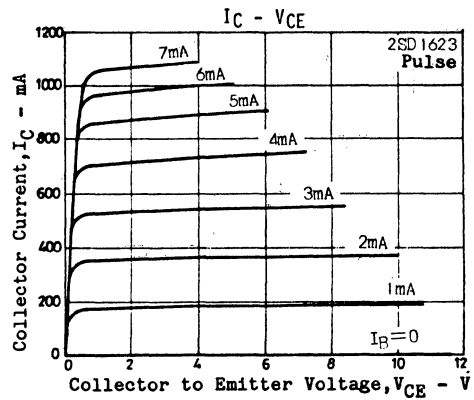
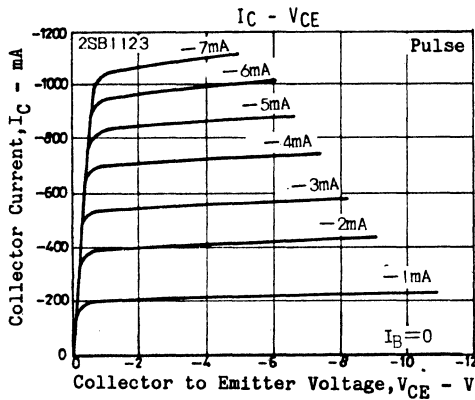
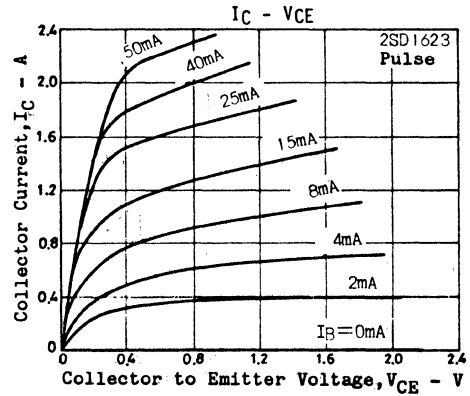
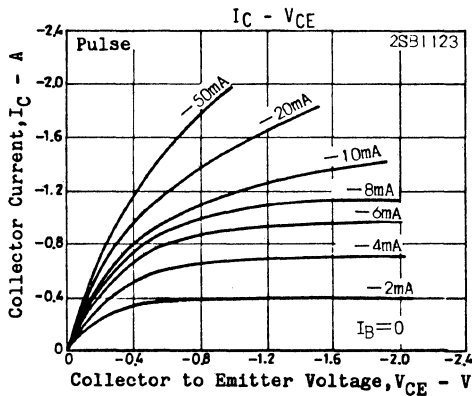


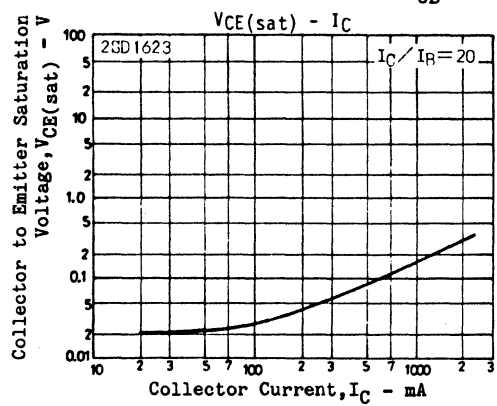
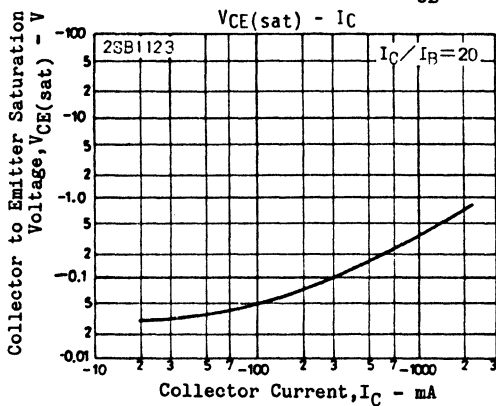
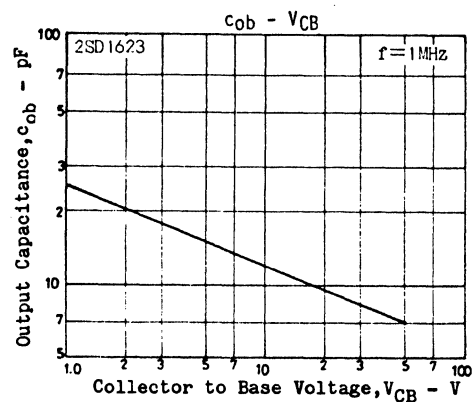
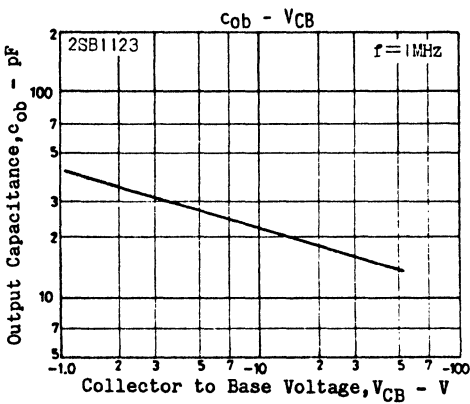
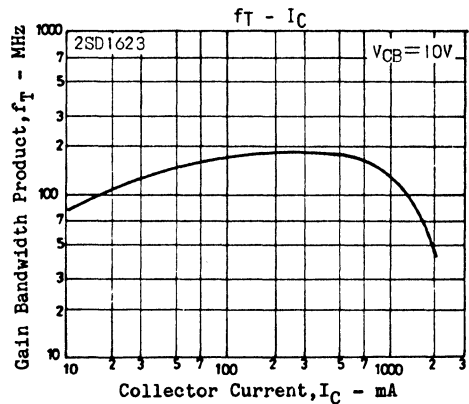
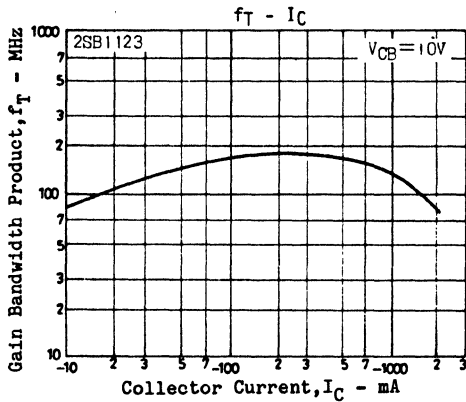
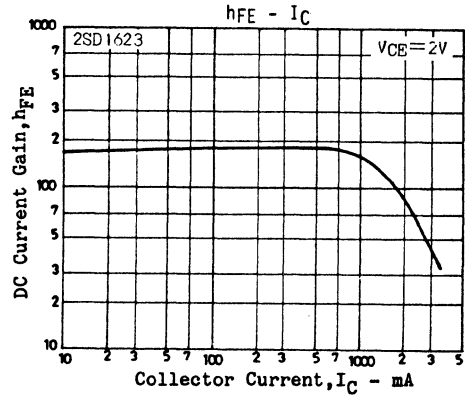
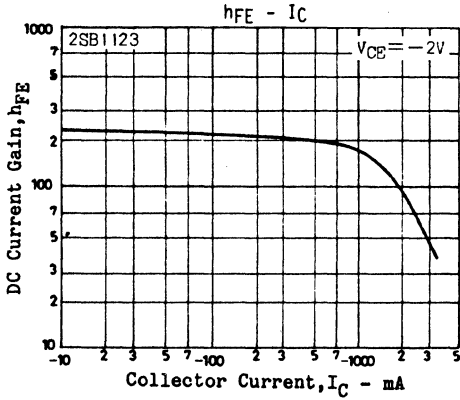
E: Emitter
C: Collector
B: Base

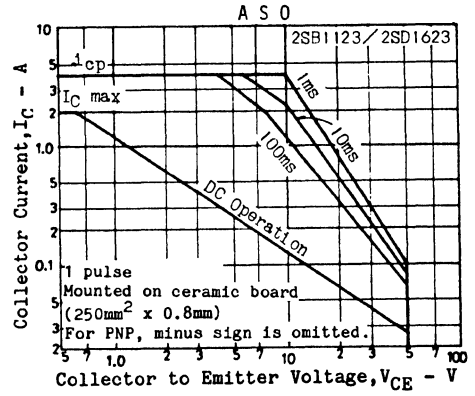
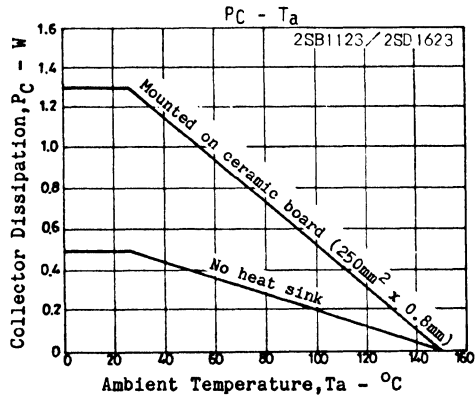
SANYO: PCP

3045MY, TS No.1727-1/4

			min	typ	max	unit
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)1A, I_B=(-)50mA$		(-0.3)(-0.7)		V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)1A, I_B=(-)50mA$		(-0.15)(-0.4)		V
C-B Breakdown Voltage	$V_{(BR)CBO}$	$I_C=(-)10uA, I_E=0$	(-)60			V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$	(-)50			V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10uA, I_C=0$	(-)6			V
Turn-ON Time	t_{on}	at specified Test Circuit		(60)60		ns
Storage Time	t_{stg}	"		(450)550		ns
Fall Time	t_f	"		(30)30		ns







2SD1626



2038

NPN/PNP Epitaxial Planar
Silicon Transistors

2SB1126

Driver Applications

©1721

Applications

- Relay drivers, hammer drivers, lamp drivers, motor drivers.

Features

- High DC current gain (4000 or greater).
- Large current capacity.
- Very small size making it easy to provide high-density, small-sized hybrid IC's.

(): 2SB1126

Absolute Maximum Ratings at Ta=25°C

			unit
Collector to Base Voltage	V_{CB0}	(-)80	V
Collector to Emitter Voltage	V_{CE0}	(-)50	V
Emitter to Base Voltage	V_{EB0}	(-)10	V
Collector Current	I_C	(-)1.5	A
Peak Collector Current	i_{cp}	(-)3	A
Collector Dissipation	$P_C(1)$	500	mW
	$P_C(2)$	Monuted on ceramic board (250mm ² x 0.8mm)	
		1.5	W
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

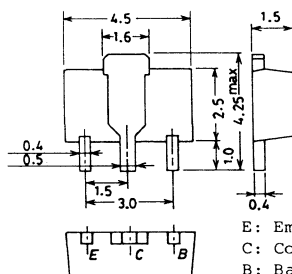
Electrical Characteristics at Ta=25°C

		min	typ	max	unit
Collector Cutoff Current	I_{CB0}	$V_{CB}=(-)40V, I_E=0$		(-)100	nA
Emitter Cutoff Current	I_{EB0}	$V_{EB}=(-)8V, I_C=0$		(-)100	nA
DC Current Gain	h_{FE1}	$V_{CE}=(-)2V, I_C=(-)500mA$		4000	
	h_{FE2}	$V_{CE}=(-)2V, I_C=(-)10mA$		3000	
Gain Bandwidth Product	f_T	$V_{CE}=(-)10V, I_C=(-)50mA$		120	MHz
C-E Saturation Voltage	$V_{CE(sat)}$	$I_C=(-)500mA, I_B=(-)0.5mA$		(-)0.9(-)1.5	V
B-E Saturation Voltage	$V_{BE(sat)}$	$I_C=(-)500mA, I_B=(-)0.5mA$		(-)1.5(-)2.0	V
C-B Breakdown Voltage	$V_{(BR)CB0}$	$I_C=(-)10uA, I_E=0$		(-)80	V
C-E Breakdown Voltage	$V_{(BR)CEO}$	$I_C=(-)1mA, R_{BE}=\infty$		(-)50	V
E-B Breakdown Voltage	$V_{(BR)EBO}$	$I_E=(-)10uA, I_C=0$		(-)10	V

Case Outline 2038

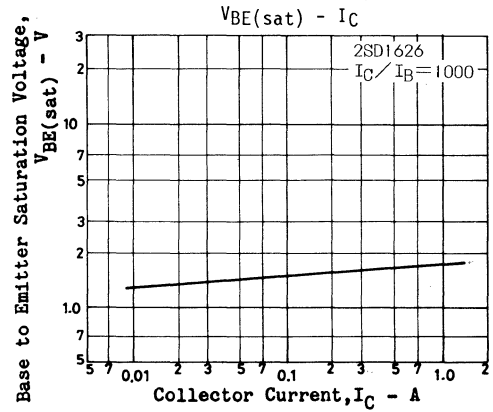
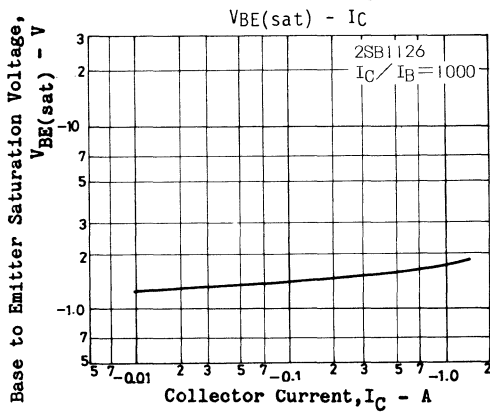
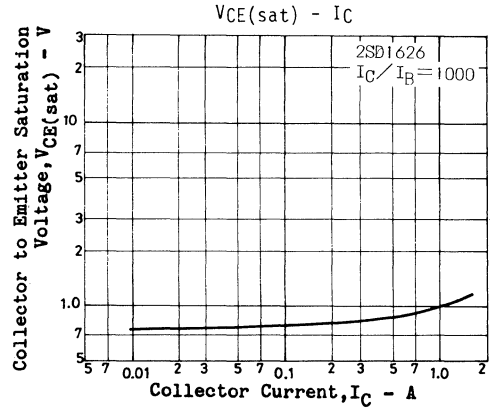
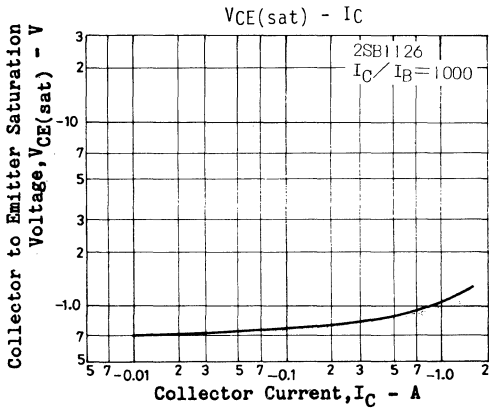
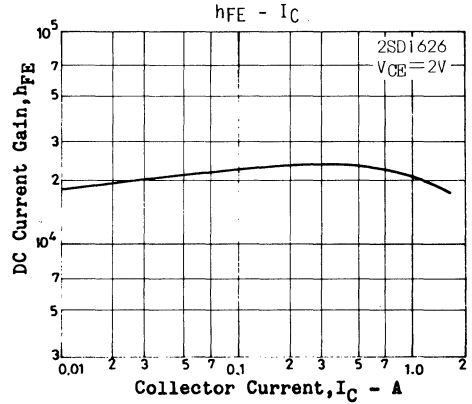
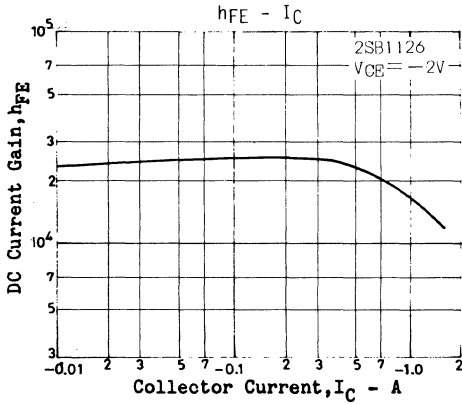
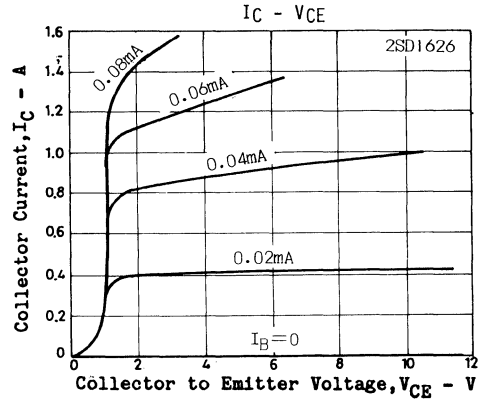
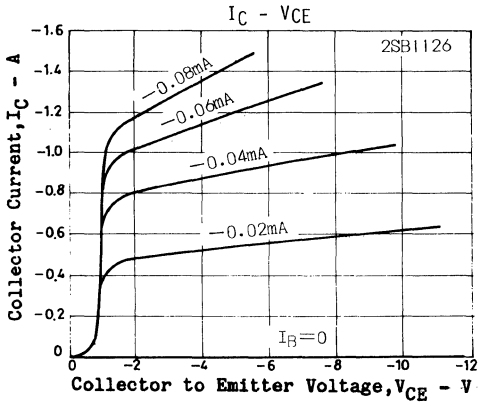
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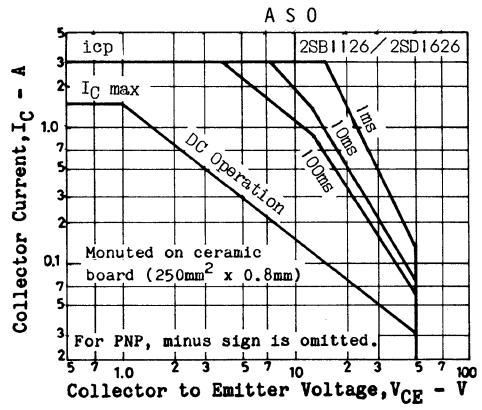
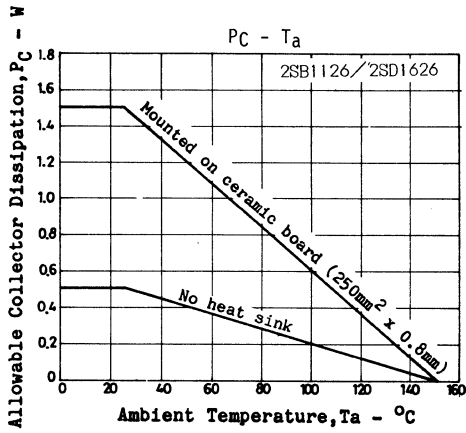
Marking 2SB1126 : BI
2SD1626 : DI



E: Emitter
C: Collector
B: Base

SANYO: PCP





2SD1628



2038

NPN Epitaxial Planar
Silicon Transistor

High Current Switching Applications

©1781

Applications

- . Strobe DC-DC converters, relay drivers, hammer drivers, lamp drivers, motor drivers.

Features

- . Low saturation voltage.
- . High h_{FE} .
- . Large current capacity.
- . Very small size making it easy to provide high-density, small-sized hybrid IC's.

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

			unit
Collector to Base Voltage	V_{CB0}	60	V
Collector to Emitter Voltage	V_{CEO}	20	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	5	A
Peak Collector Current	i_{cp}	8	A
Collector Dissipation	P_C	500	mW
	P_C^*	1.5	W
Junction Temperature	T_j	150	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^{\circ}\text{C}$

* Mounted on ceramic board (250mm² x 0.8mm)

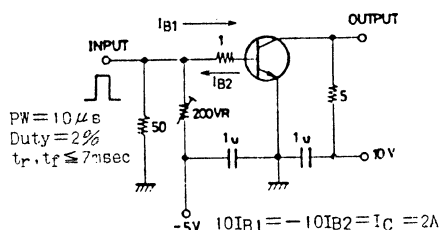
Electrical Characteristics at $T_a=25^{\circ}\text{C}$

		min	typ	max	unit
Collector Cutoff Current	I_{CB0} $V_{CB}=50\text{V}, I_E=0$			100	nA
Emitter Cutoff Current	I_{EB0} $V_{EB}=5\text{V}, I_C=0$			100	nA
DC Current Gain	$h_{FE}(1)^*$ $V_{CE}=2\text{V}, I_C=0.5\text{A}$	120		560	
	$h_{FE}(2)$ $V_{CE}=2\text{V}, I_C=3\text{A}$	95			
Gain Bandwidth Product	f_T $V_{CE}=10\text{V}, I_C=50\text{mA}$		120		MHz
Output Capacitance	c_{ob} $V_{CB}=10\text{V}, f=1\text{MHz}$		45		pF
C-E Saturation Voltage	$V_{CE(sat)}$ $I_C=3\text{A}, I_B=60\text{mA}$			500	mV
B-E Saturation Voltage	$V_{BE(sat)}$ $I_C=3\text{A}, I_B=60\text{mA}$			1.5	V
Turn-ON Time	t_{on} at specified Test Circuit		30		ns
Storage Time	t_{stg}		300		ns
Fall Time	t_f		40		ns

* The 2SD1628 is classified by 0.5A h_{FE} as follows:

120	E	200	160	F	320	280	G	560
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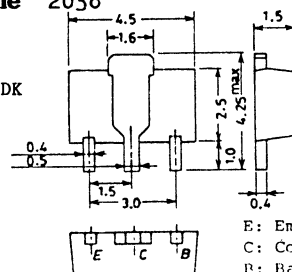
Switching Time Test Circuit



Case Outline 2038

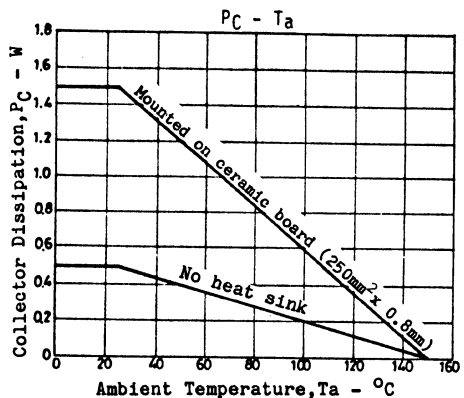
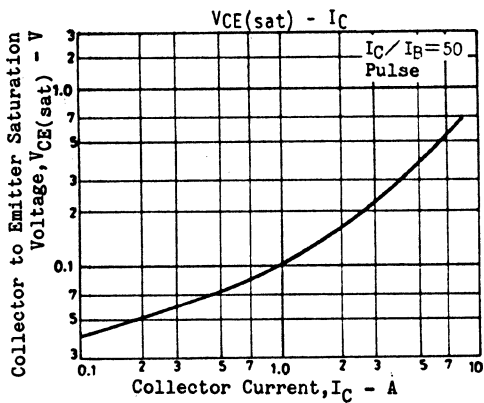
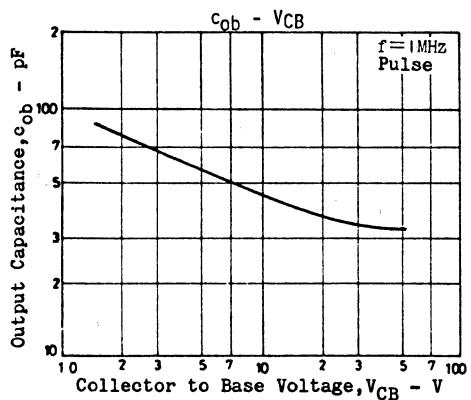
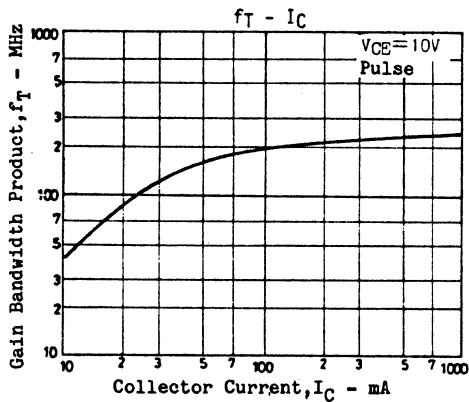
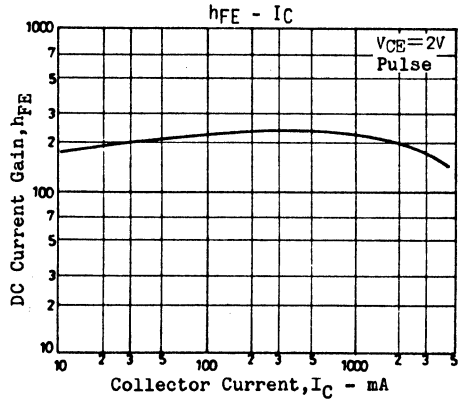
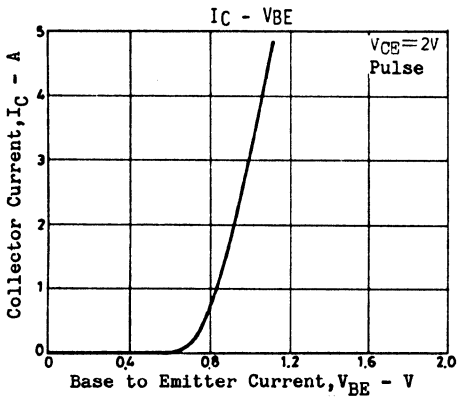
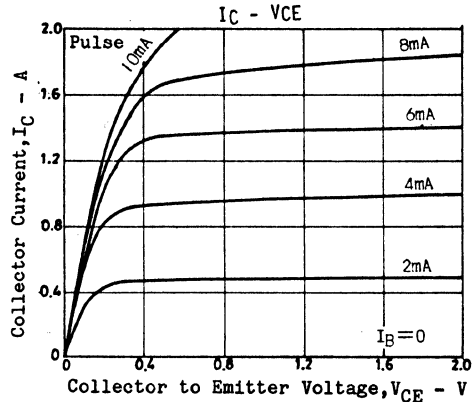
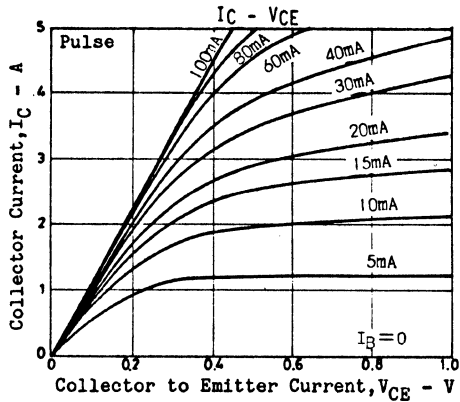
(unit:mm)

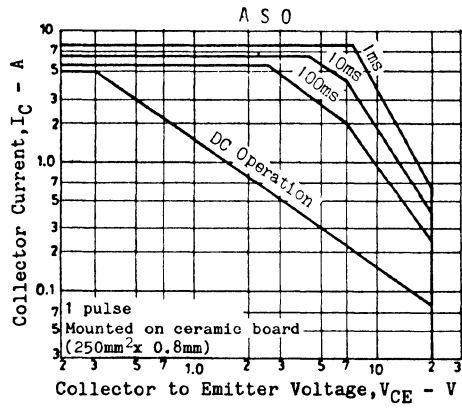
Marking: DK



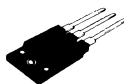
E: Emitter
C: Collector
B: Base

SANYO: FCP





2SD1649



2039

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications (with Damper Diode)

©1755

Applications

- High-voltage, power switching

Features

- Fast speed ($t_{fmax}=0.7\mu s$).
- High reliability (Adoption of HVP process).
- High breakdown voltage ($V_{CBO}=1500V$).
- Micaless package facilitating mounting operation.

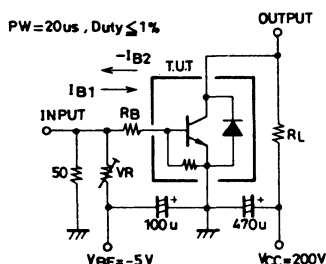
Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	2.5	A
Peak Collector Current	i_{cp}	10	A
Collector Dissipation	P_C	50	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

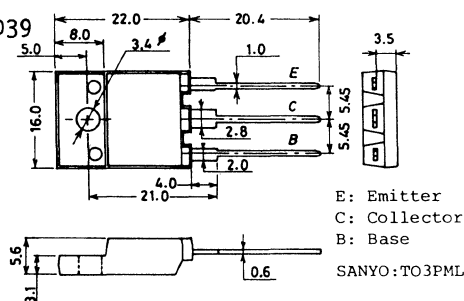
Electrical Characteristics at $T_a=25^\circ C$

		min	typ	max	unit
Collector Cutoff Current	I_{CBO}			10	μA
Emitter Cutoff Current	I_{EBO}			130	mA
DC Current Gain	h_{FE}	8			
Gain Bandwidth Product	f_T		3		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$			8	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$			1.5	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	1500			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	800			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	7			V
Diode Forward Voltage	V_F			2	V
Fall Time	t_f			0.7	μs

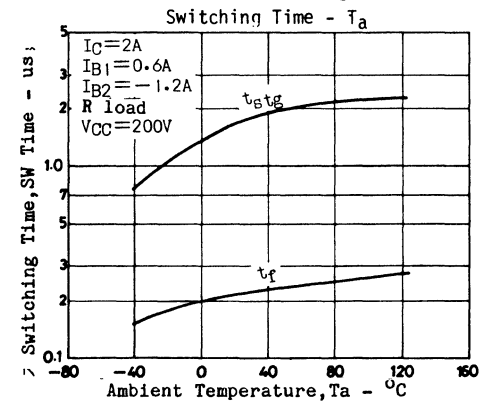
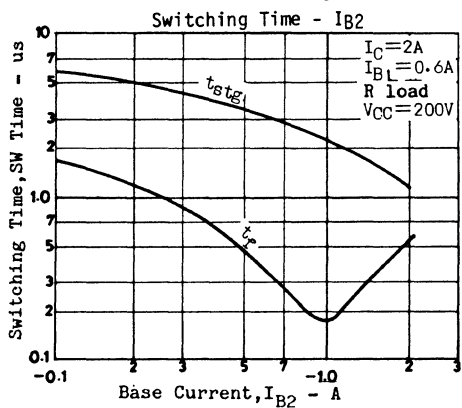
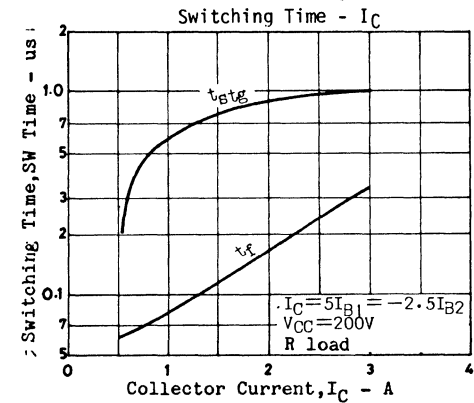
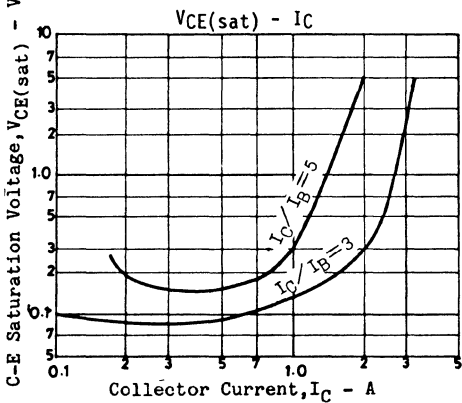
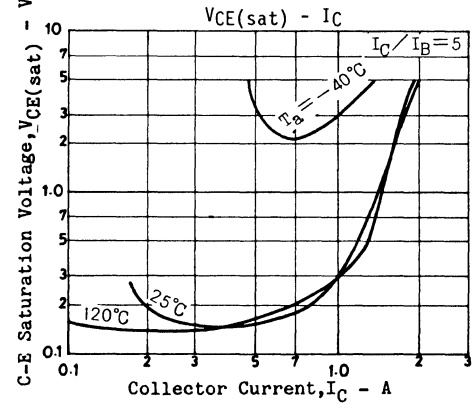
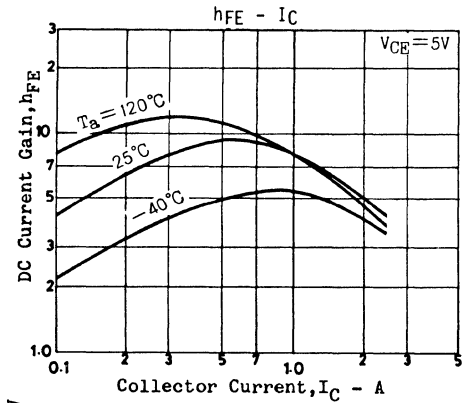
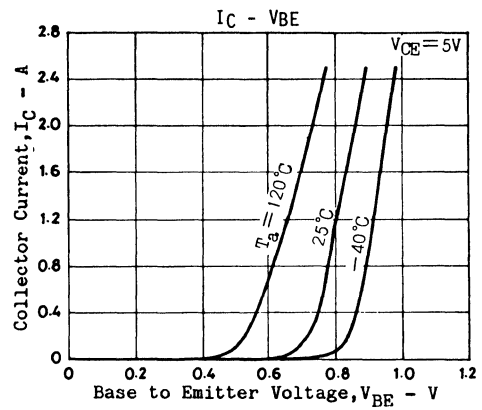
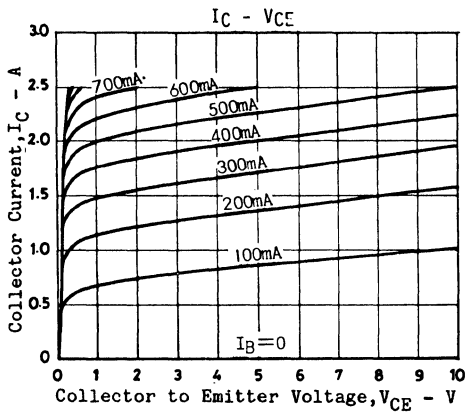
Switching Time Test Circuit

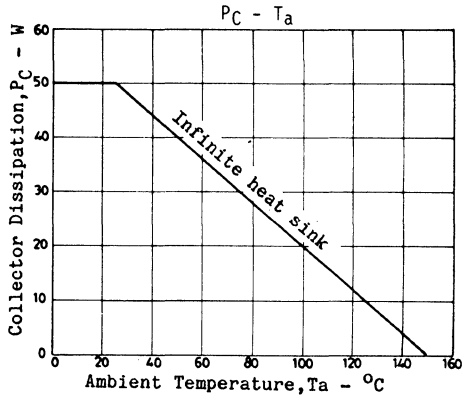
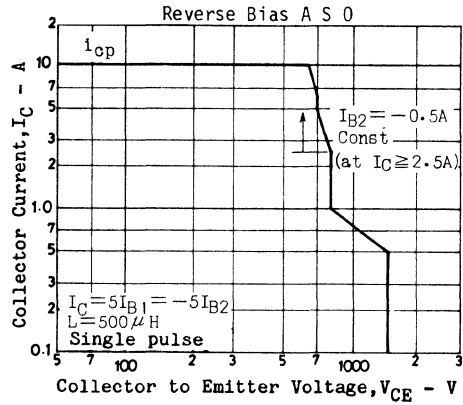
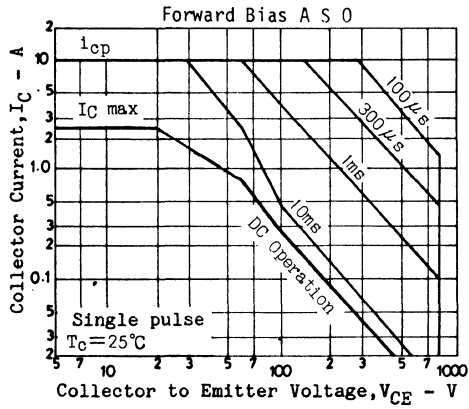


Case Outline 2039 (unit:mm)

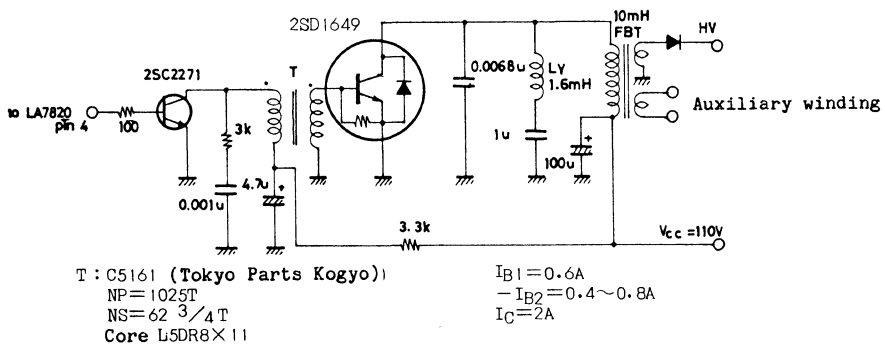


D244KI, TS No.1755-1/3





Sample Application Circuit



2SD1650



2039

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications (with Damper Diode)

©1748

Applications

- High-voltage, power switching

Features

- Fast speed ($t_{pmax}=0.7\mu s$).
- High reliability (Adoption of HVP process).
- High breakdown voltage ($V_{CBO}=1500V$).
- Micaless package facilitating mounting operation.

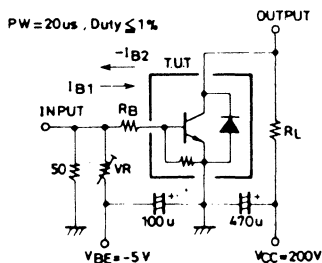
Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	3.5	A
Peak Collector Current	i_{ep}	10	A
Collector Dissipation	P_C	50	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

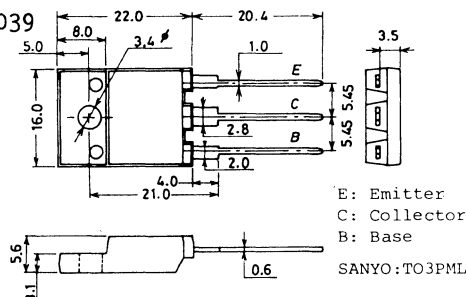
Electrical Characteristics at $T_a=25^\circ C$

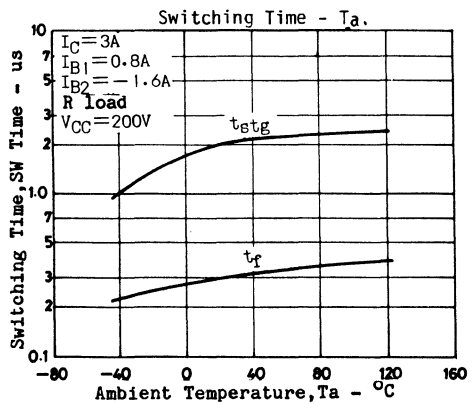
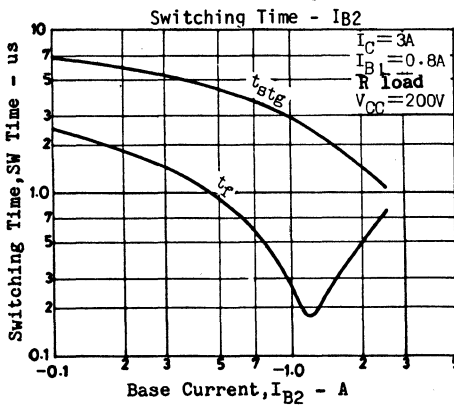
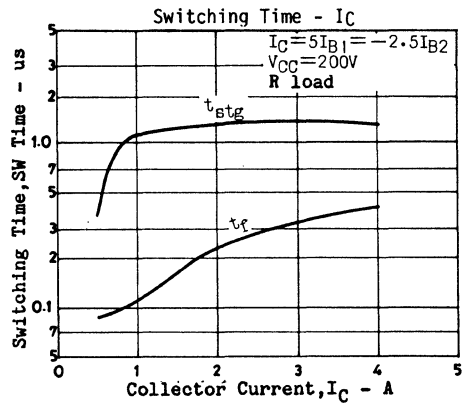
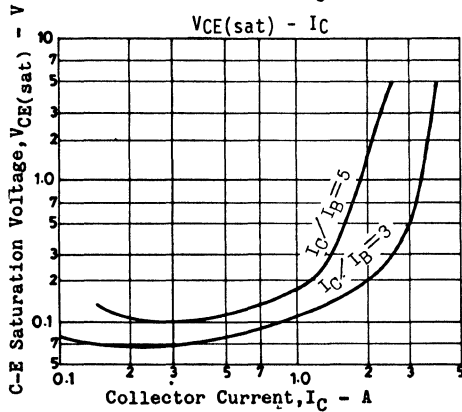
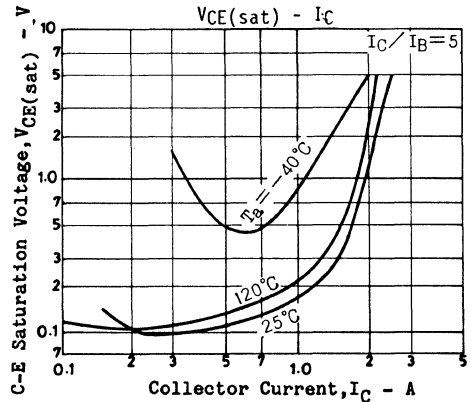
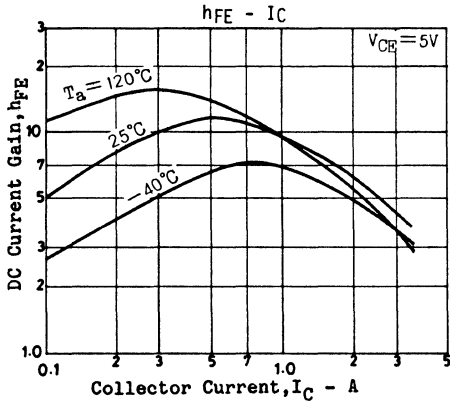
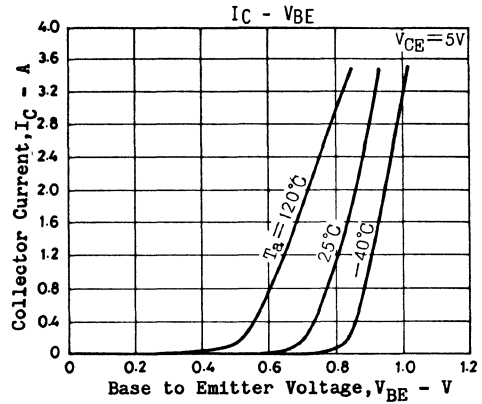
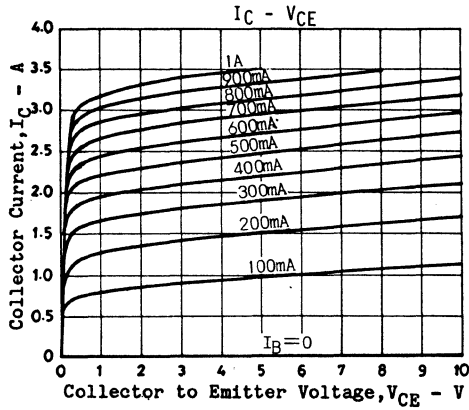
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4V, I_C=0$	40		130	mA
DC Current Gain	h_{FE}	$V_{CE}=5V, I_C=0.5A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.5A$		3		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=2.5A, I_B=0.8A$			8	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=2.5A, I_B=0.8A$			1.5	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5mA, I_E=0$	1500			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=100mA, R_{BE}=\infty$	800			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=200mA, I_C=0$	7			V
Diode Forward Voltage	V_F	$I_{EC}=3.5A$			2	V
Fall Time	t_f	$I_C=3A, I_{B1}=0.8A, I_{B2}=-1.6A, V_{CC}=200V, R_L=66.7\Omega$			0.7	μs

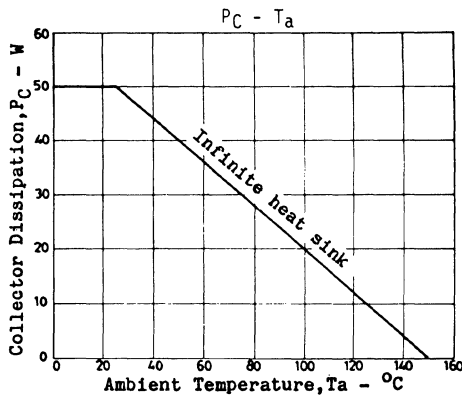
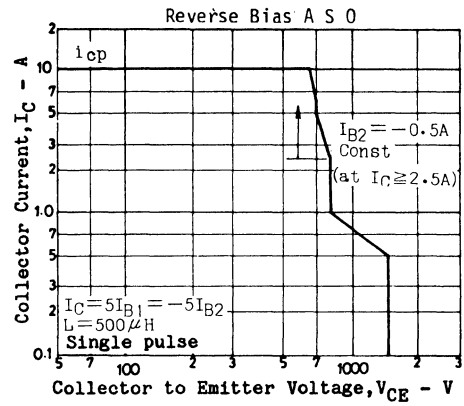
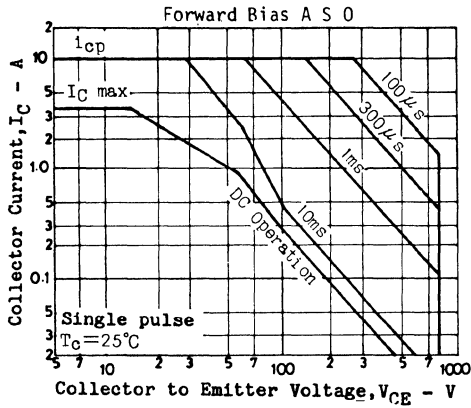
Switching Time Test Circuit



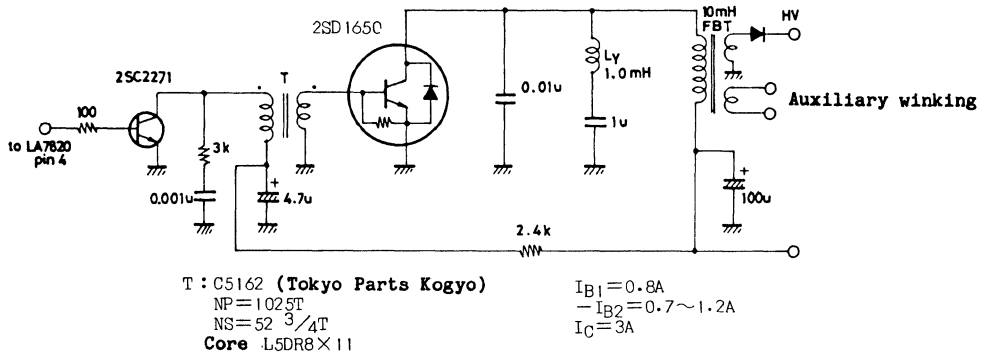
Case Outline 2039 (unit:mm)



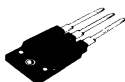




Sample Application Circuit



2SD1651



2039

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications (with Damper Diode)

©1749

Applications

- High-voltage, power switching

Features

- Fast speed ($t_{p,max}=0.7\mu s$).
- High reliability (Adoption of HVP process).
- High breakdown voltage ($V_{CBO}=1500V$).
- Micaless package facilitating mounting operation.

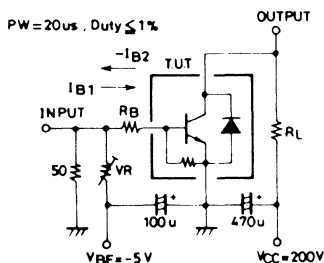
Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	5	A
Peak Collector Current	i_{cp}	16	A
Collector Dissipation	P_C	60	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

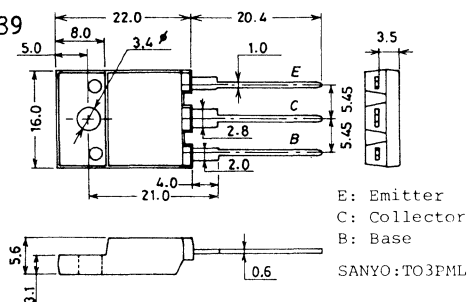
Electrical Characteristics at $T_a=25^\circ C$

		min	typ	max	unit
Collector Cutoff Current	I_{CBO} $V_{CB}=800V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO} $V_{EB}=4V, I_C=0$	40		130	mA
DC Current Gain	h_{FE} $V_{CE}=5V, I_C=1A$	8			
Gain Bandwidth Product	f_T $V_{CE}=10V, I_C=1A$		3		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$ $I_C=4A, I_B=0.8A$			5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$ $I_C=4A, I_B=0.8A$			1.5	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$ $I_C=5mA, I_E=0$	1500			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$ $I_C=100mA, R_{BE}=\infty$	800			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$ $I_E=200mA, I_C=0$	7			V
Diode Forward Voltage	V_F $I_{EC}=5A$			2	V
Fall Time	t_f $I_C=4A, I_{B1}=0.8A, I_{B2}=-1.6A, V_{CC}=200V, R_L=50\Omega$			0.7	μs

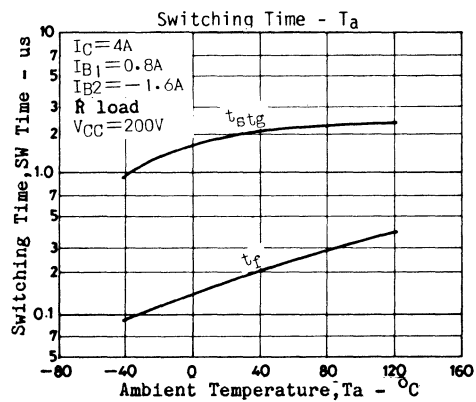
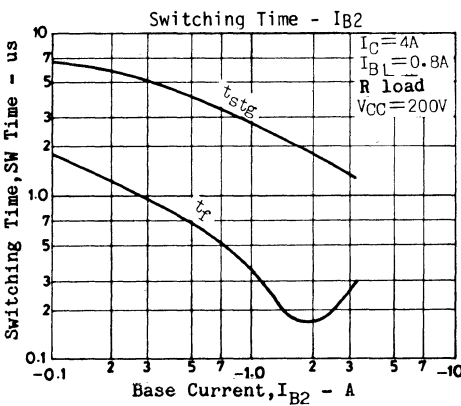
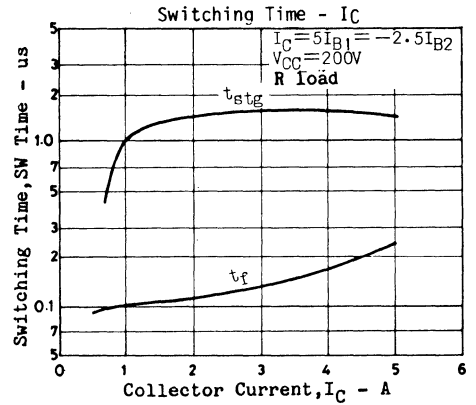
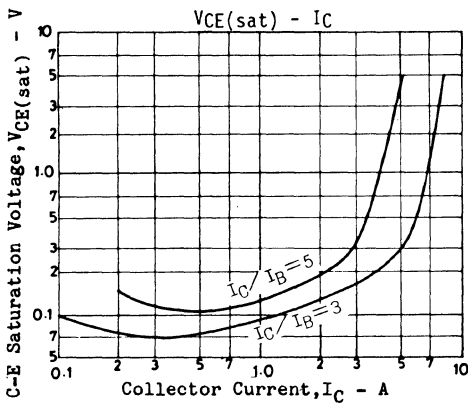
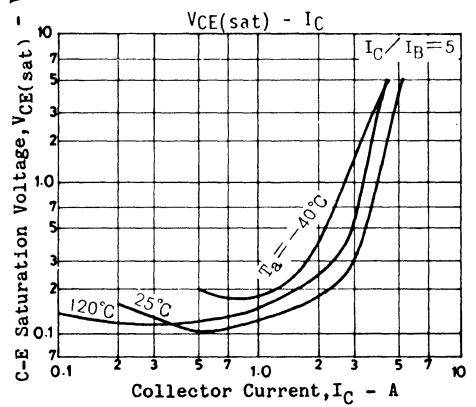
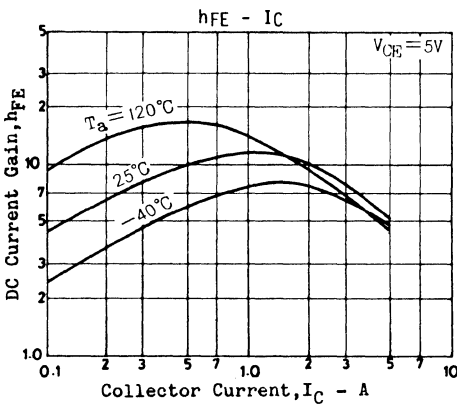
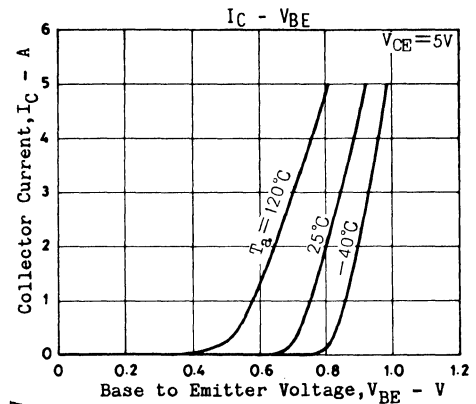
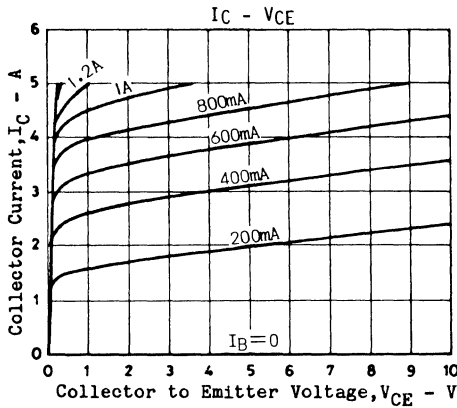
Switching Time Test Circuit

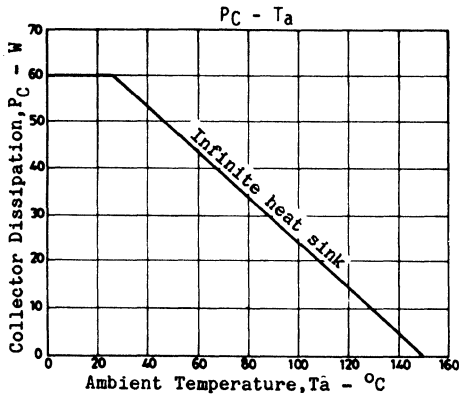
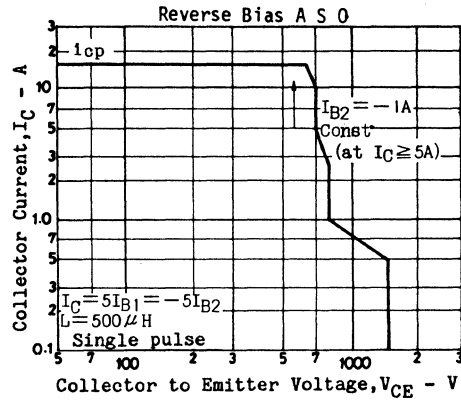
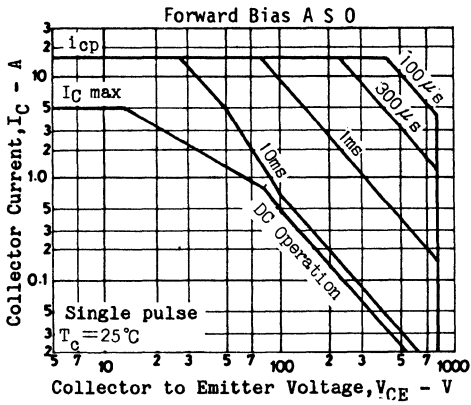


Case Outline 2039 (unit:mm)

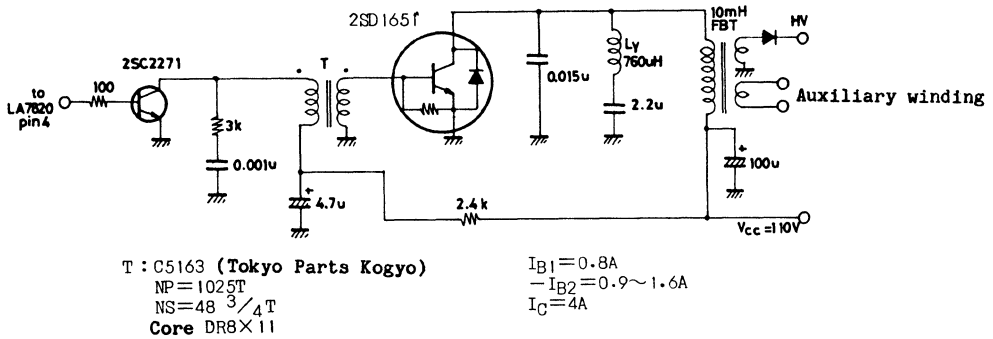


D244KI, TS No.1749-1/3

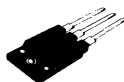




Sample Application Circuit



2SD1652



2039

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications (with Damper Diode)

©1750

Applications

- High-voltage, power switching

Features

- Fast speed ($t_{max}=0.7\mu s$).
- High reliability (Adoption of HVP process).
- High breakdown voltage ($V_{CBO}=1500V$).
- Micaless package facilitating mounting operation.

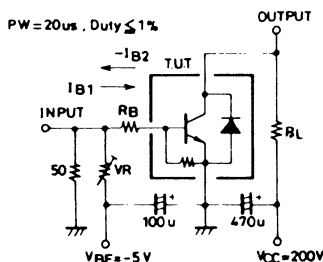
Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	6	A
Peak Collector Current	i_{cp}	16	A
Collector Dissipation	P_C	60	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

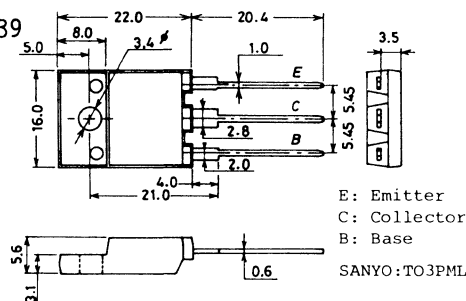
Electrical Characteristics at $T_a=25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=4V, I_C=0$	40		130	mA
DC Current Gain	h_{FE}	$V_{CE}=5V, I_C=1A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=1A$		3		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=5A, I_B=1A$			5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=5A, I_B=1A$			1.5	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5mA, I_E=0$	1500			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=100mA, R_{BE}=\infty$	800			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=200mA, I_C=0$	7			V
Diode Forward Voltage	V_F	$I_{EC}=6A$			2	V
Fall Time	t_f	$I_C=5A, I_{B1}=1A, I_{B2}=-2A, V_{CC}=200V, R_L=40\Omega$			0.7	μs

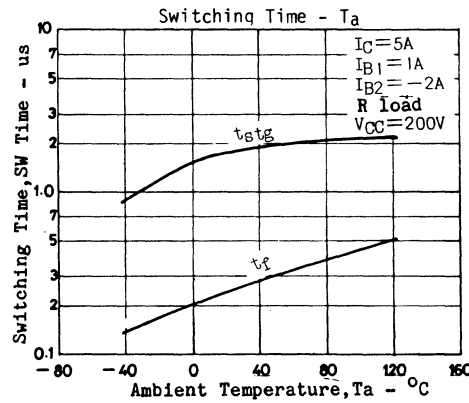
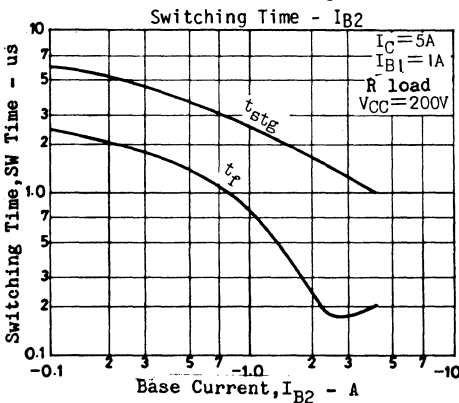
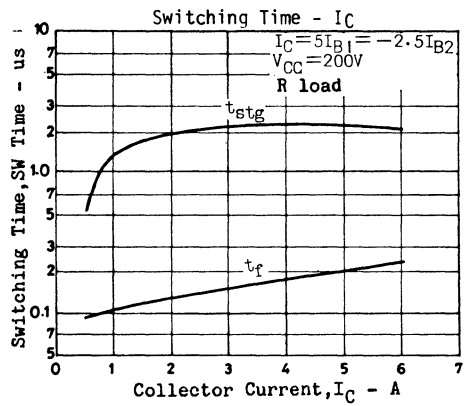
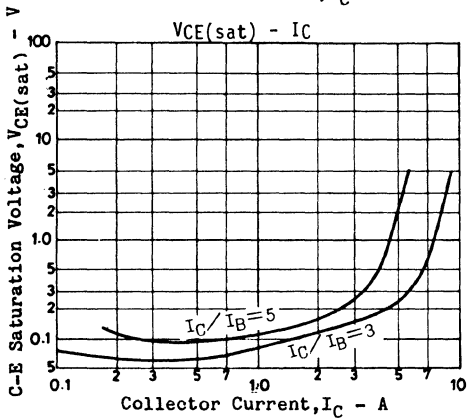
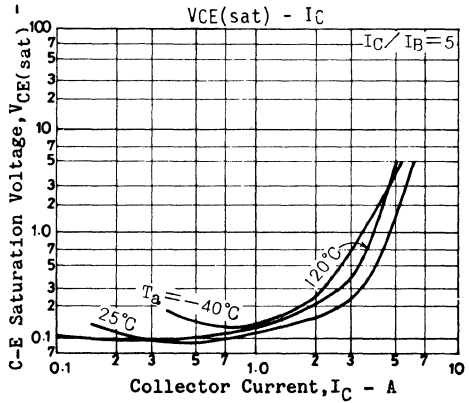
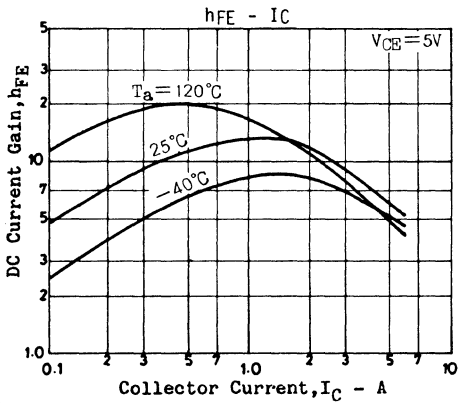
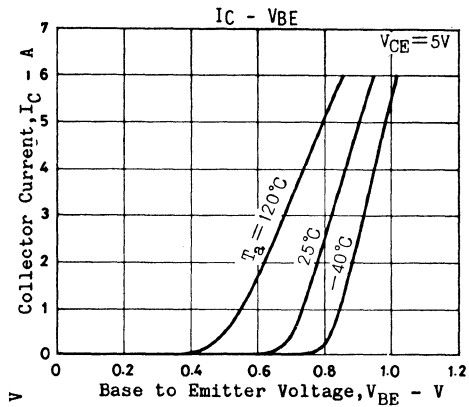
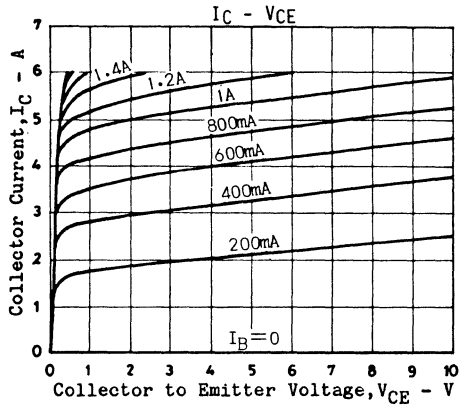
Switching Time Test Circuit

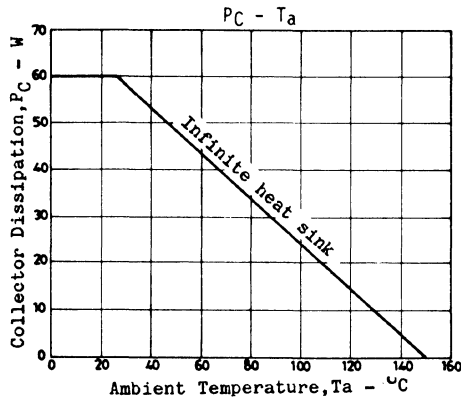
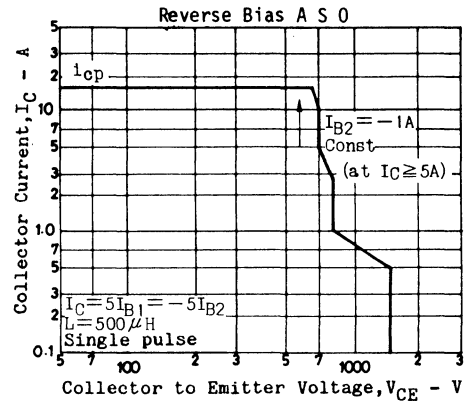
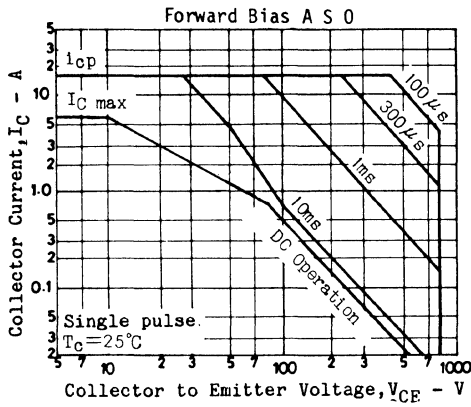


Case Outline 2039 (unit:mm)

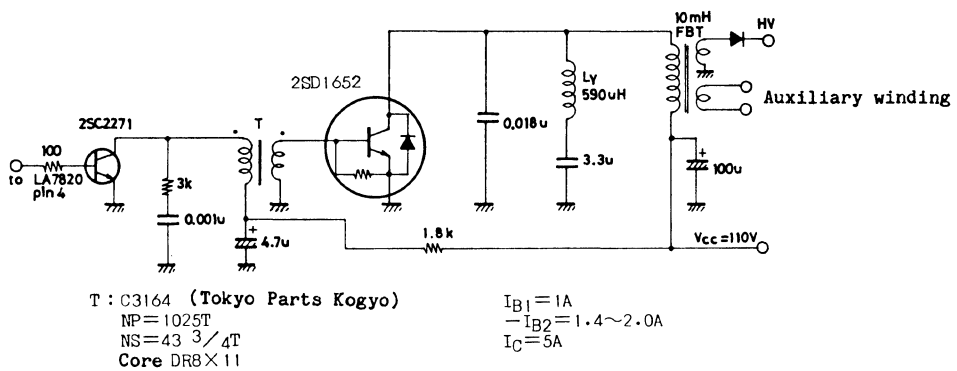


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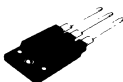




Sample Application Circuit



2SD1653



2039

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications (with Damper Diode)

©1751

Applications

- High-voltage, power switching

Features

- Fast speed ($t_{pmax}=0.7\mu s$).
- High reliability (Adoption of HVP process).
- High breakdown voltage ($V_{CBO}=1500V$).
- Micaless package facilitating mounting operation.

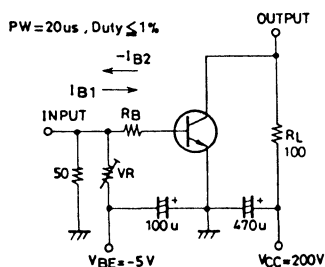
Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	2.5	A
Peak Collector Current	i_{cp}	10	A
Collector Dissipation	P_C	50	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

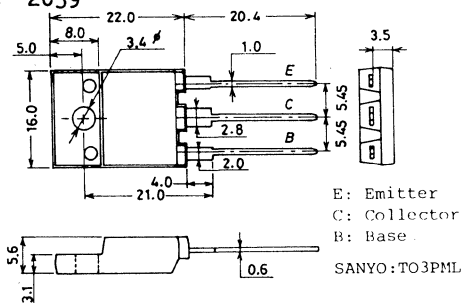
Electrical Characteristics at $T_a=25^\circ C$

		min	typ	max	unit
Collector Cutoff Current	I_{CBO} $V_{CB}=800V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO} $V_{EB}=5V, I_C=0$			1	mA
DC Current Gain	h_{FE} $V_{CE}=5V, I_C=0.5A$	8			
Gain Bandwidth Product	f_T $V_{CE}=10V, I_C=0.5A$		3		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$ $I_C=2A, I_B=0.6A$			8	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$ $I_C=2.5A, I_B=0.8A$			1.5	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$ $I_C=5mA, I_E=0$	1500			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$ $I_C=100mA, R_{BE}=\infty$	800			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$ $I_E=200mA, I_C=0$	7			V
Fall Time	t_f $I_C=2A, I_{B1}=0.6A, I_{B2}=-1.2A$			0.7	μs

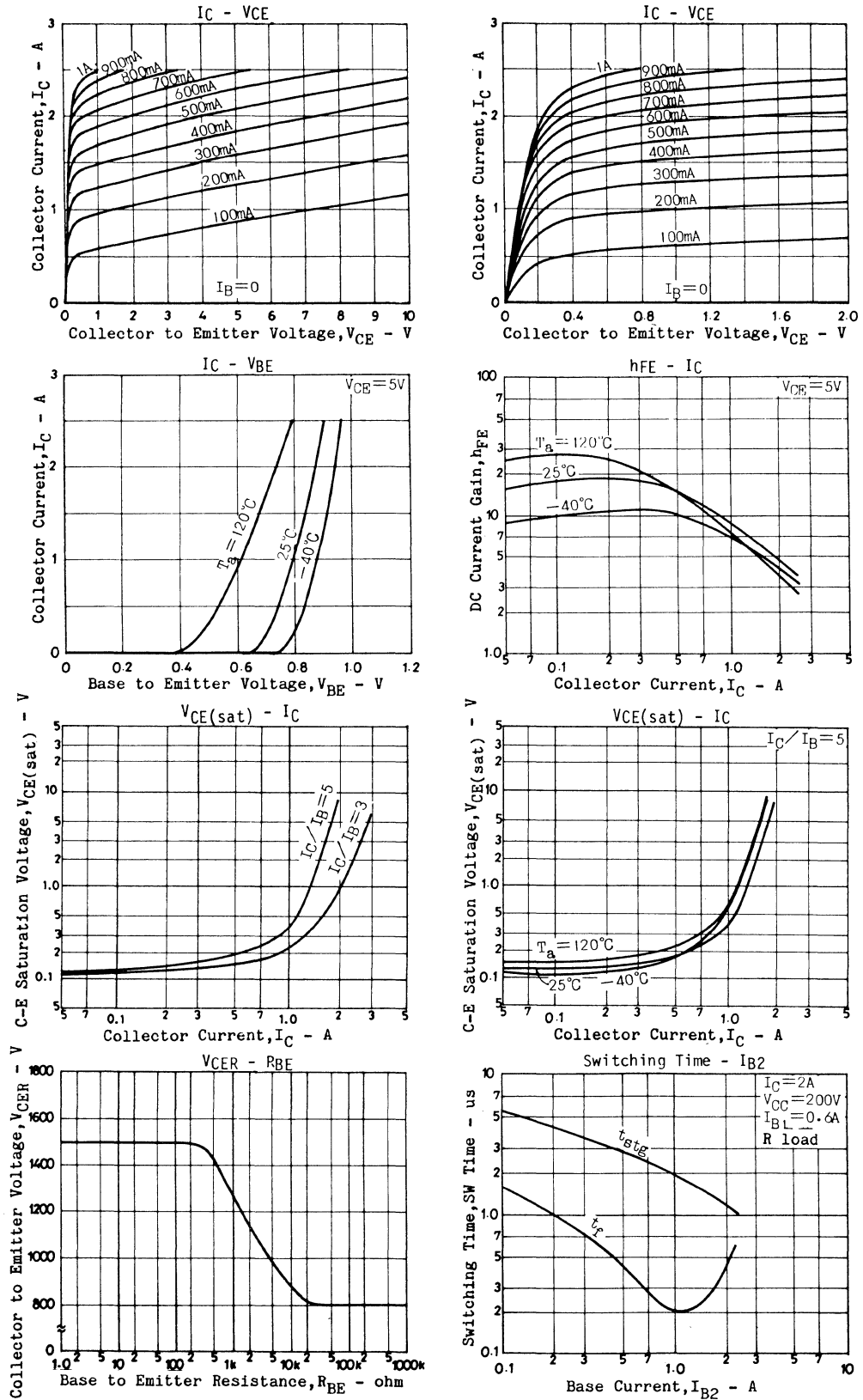
Switching Time Test Circuit

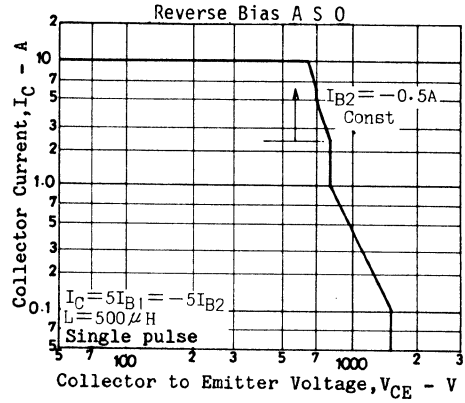
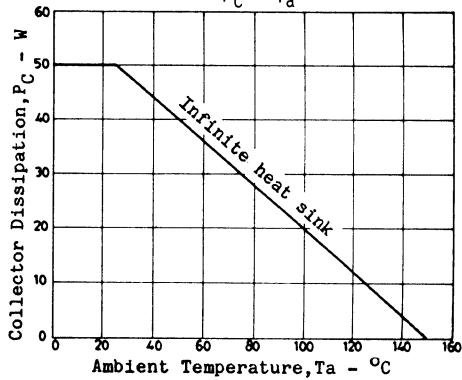
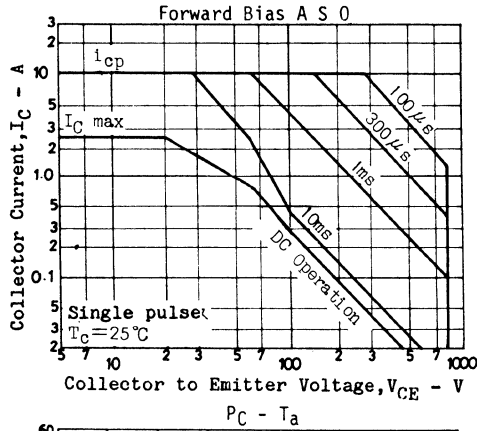


Case Outline 2039 (unit:mm)

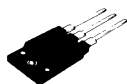


D244KI, TS No.1751-1/3





2SD1654



2039

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications (with Damper Diode)

©1752

Applications

- . High-voltage, power switching

Features

- . Fast speed ($t_{fmax}=0.7\mu s$).
- . High reliability (Adoption of HVP process).
- . High breakdown voltage ($V_{CBO}=1500V$).
- . Micaless package facilitating mounting operation.

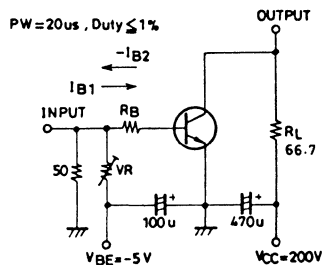
Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	3.5	A
Peak Collector Current	i_{cp}	10	A
Collector Dissipation	P_C	50	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

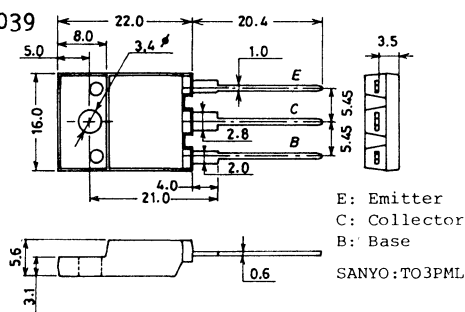
Electrical Characteristics at $T_a=25^\circ C$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			1	mA
DC Current Gain	h_{FE}	$V_{CE}=5V, I_C=0.5A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=0.5A$		3		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=2.5A, I_B=0.8A$			8	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=2.5A, I_B=0.8A$			1.5	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5mA, I_E=0$	1500			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=100mA, R_{BE}=\infty$	800			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=200mA, I_C=0$	7			V
Fall Time	t_f	$I_C=3A, I_{B1}=0.8A, I_{B2}=-1.6A$			0.7	μs

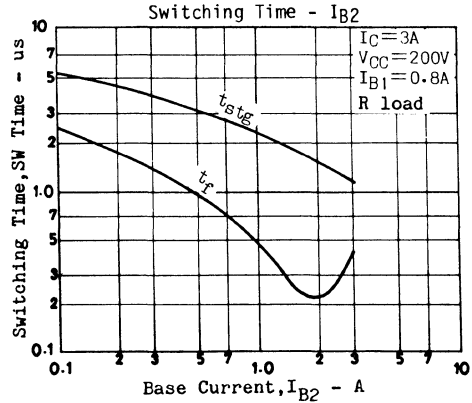
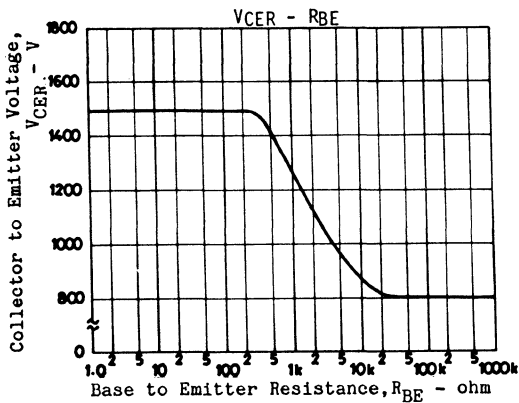
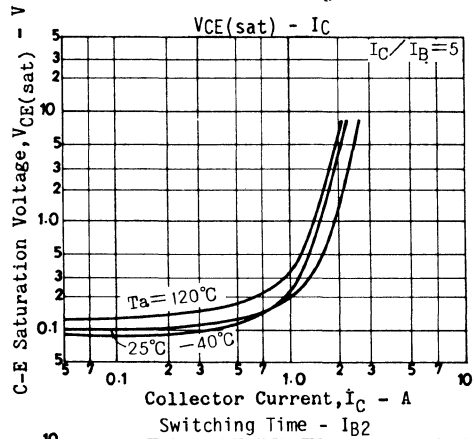
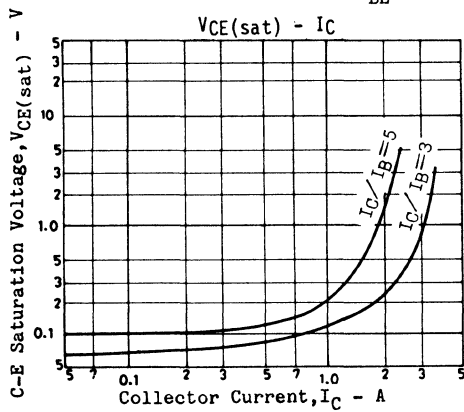
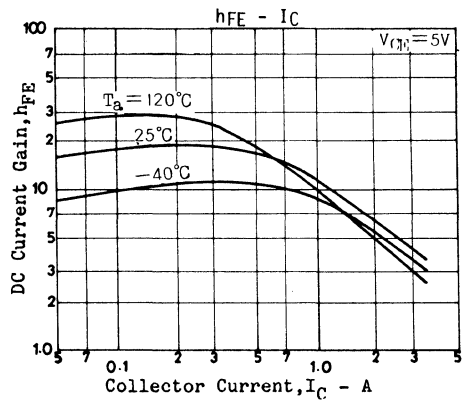
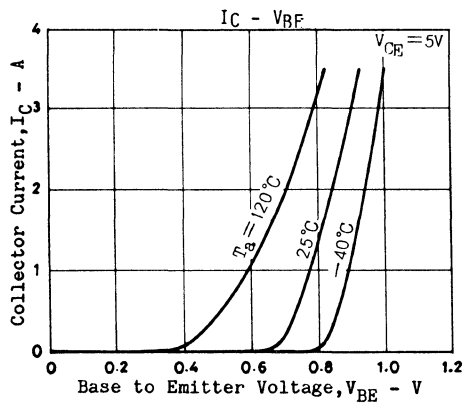
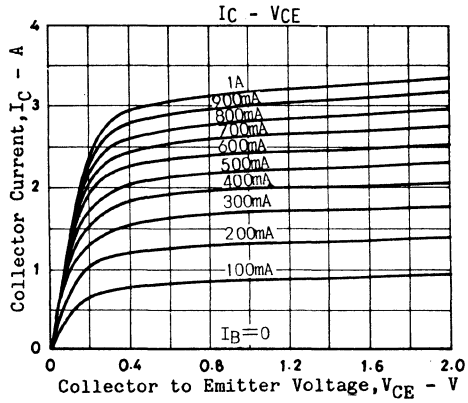
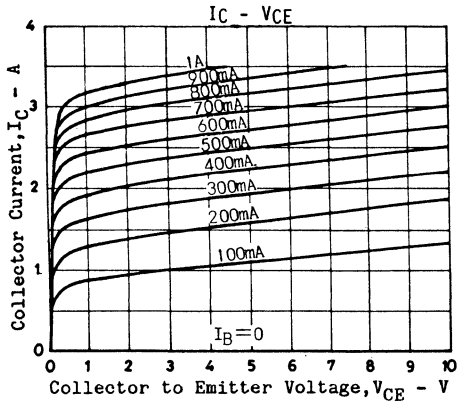
Switching Time Test Circuit

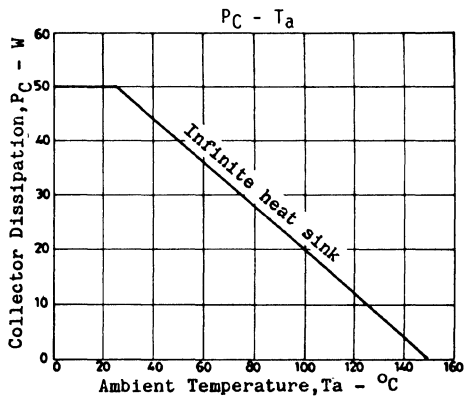
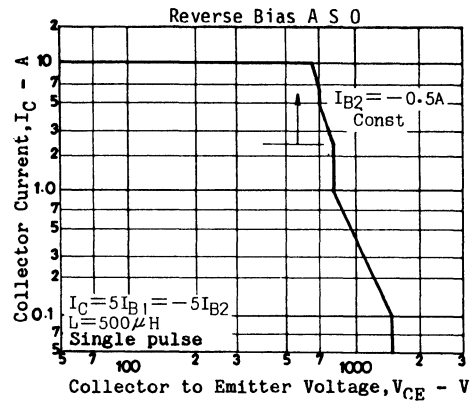
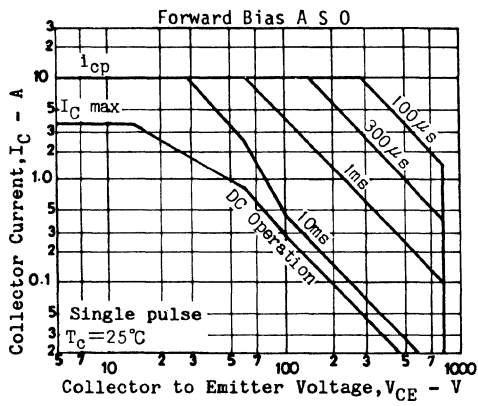


Case Outline 2039 (unit:mm)

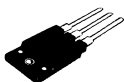


E: Emitter
C: Collector
B: Base
SANYO: TO3PML





2SD1655



2039

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications (with Damper Diode)

©1753

Applications

- High-voltage, power switching

Features

- Fast speed ($t_{fmax}=0.7\mu s$).
- High reliability (Adoption of HVP process).
- High breakdown voltage ($V_{CBO}=1500V$).
- Micaless package facilitating mounting operation.

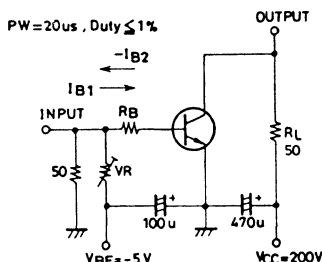
Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	5	A
Peak Collector Current	i_{cp}	16	A
Collector Dissipation	P_C	60	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

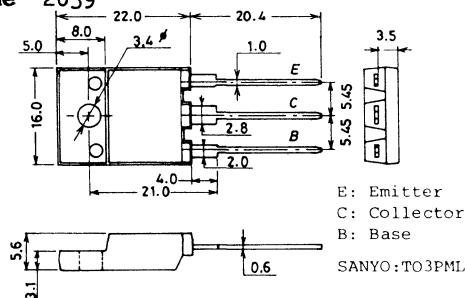
Electrical Characteristics at $T_a=25^\circ C$

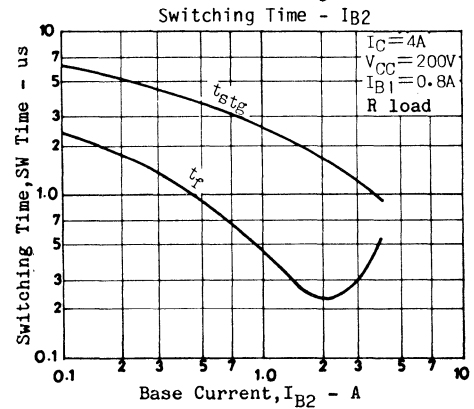
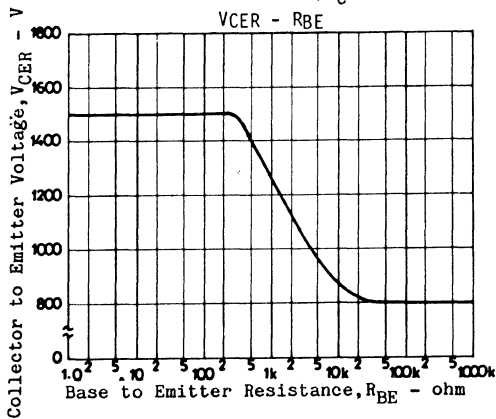
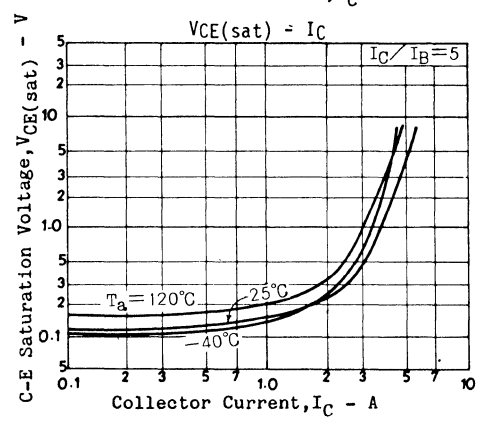
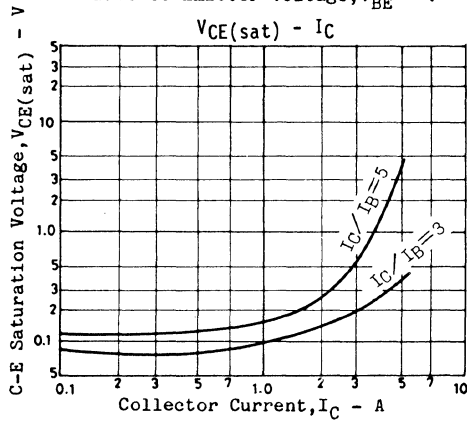
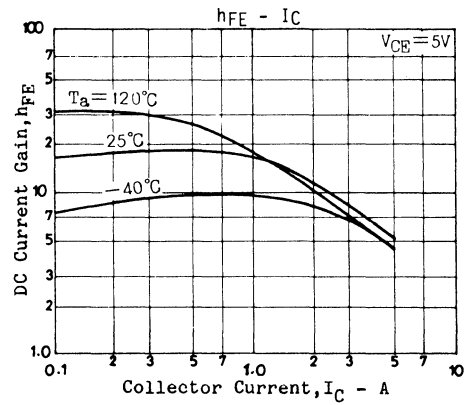
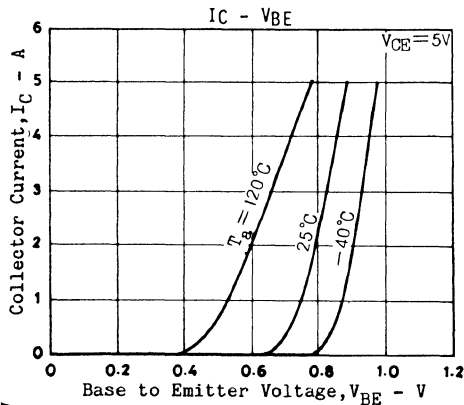
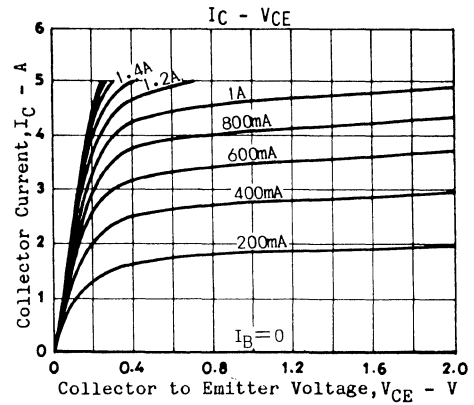
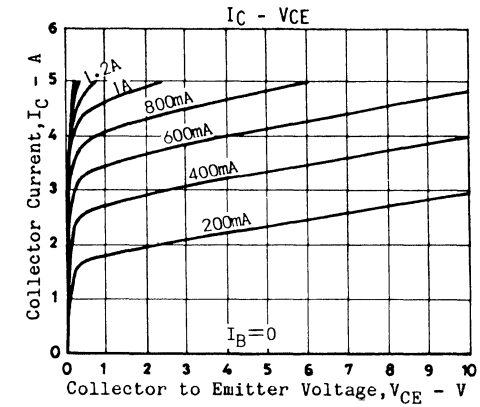
		min	typ	max	unit
Collector Cutoff Current	I_{CBO} $V_{CB}=800V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO} $V_{EB}=5V, I_C=0$			1	mA
DC Current Gain	h_{FE} $V_{CE}=5V, I_C=1A$	8			
Gain Bandwidth Product	f_T $V_{CE}=10V, I_C=1A$		3		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$ $I_C=4A, I_B=0.8A$			5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$ $I_C=4A, I_B=0.8A$			1.5	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$ $I_C=5mA, I_E=0$	1500			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$ $I_C=100mA, R_{BE}=\infty$	800			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$ $I_E=200mA, I_C=0$	7			V
Fall Time	t_f $I_C=4A, I_{B1}=0.8A, I_{B2}=-1.6A$			0.7	μs

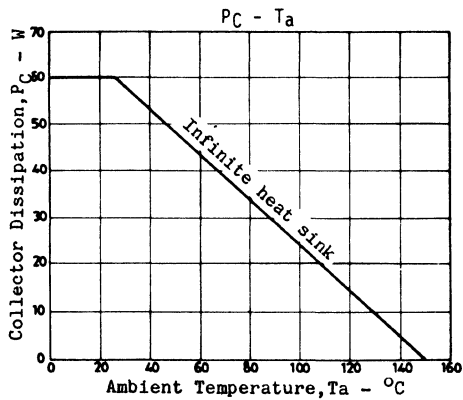
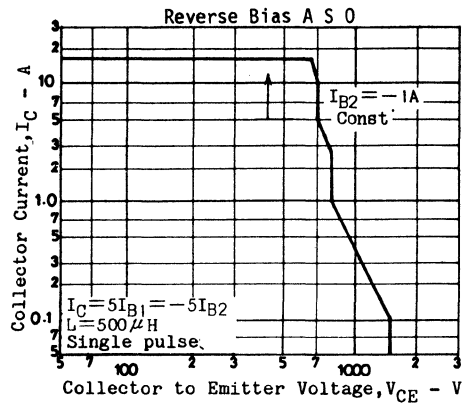
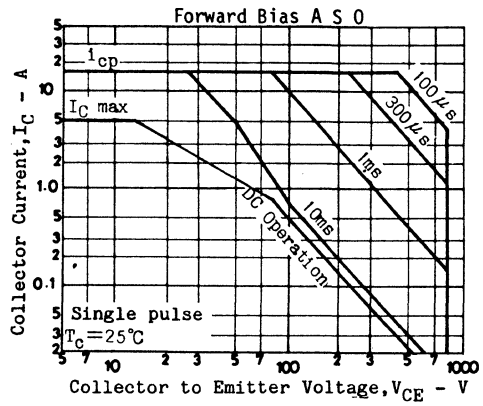
Switching Time Test Circuit



Case Outline 2039 (unit:mm)







2SD1656



2039

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications (with Damper Diode)

©1754

Applications

- High-voltage, power switching

Features

- Fast speed ($t_{fmax}=0.7\mu s$).
- High reliability (Adoption of HVP process).
- High breakdown voltage ($V_{CBO}=1500V$).
- Micaless package facilitating mounting operation.

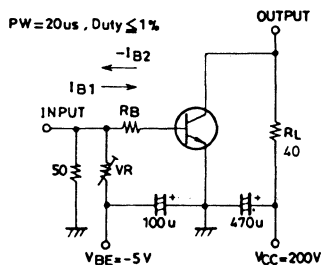
Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	6	A
Peak Collector Current	i_{cp}	16	A
Collector Dissipation	P_C	60	W
Junction Temperature	T_J	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

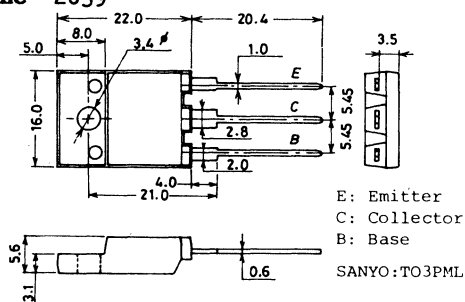
Electrical Characteristics at $T_a=25^\circ C$

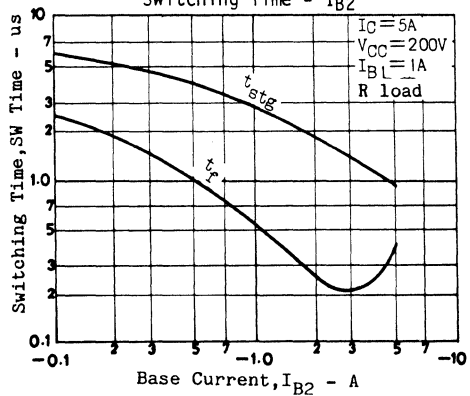
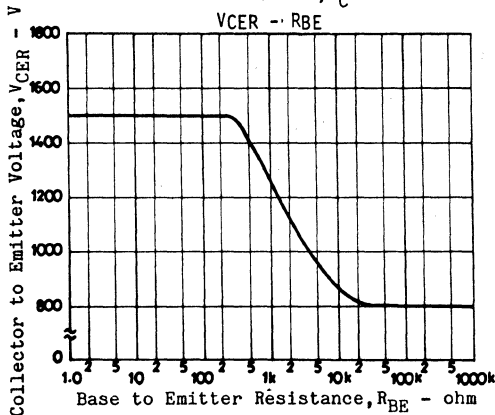
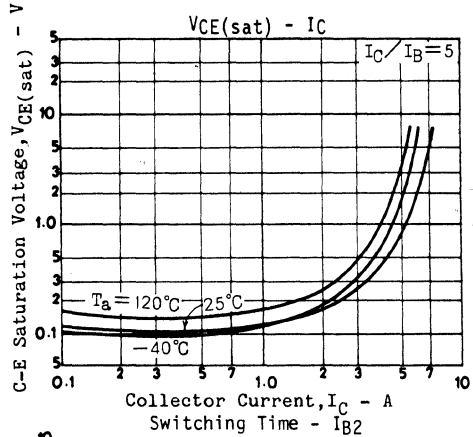
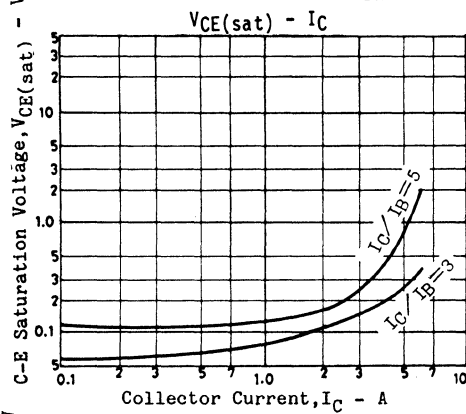
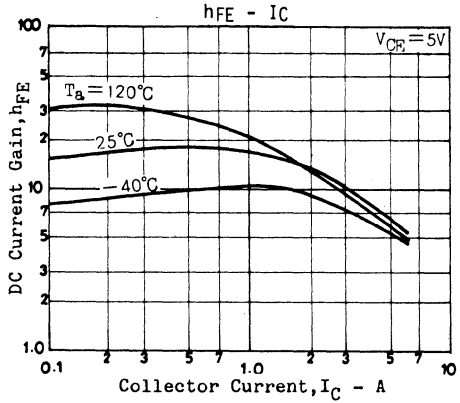
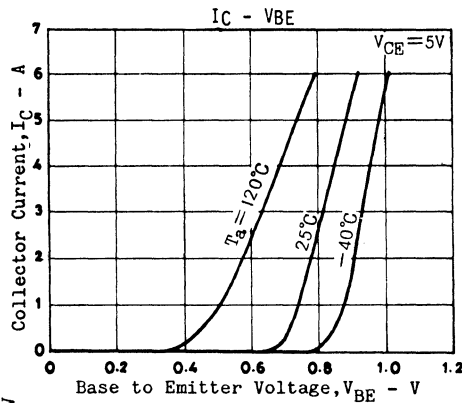
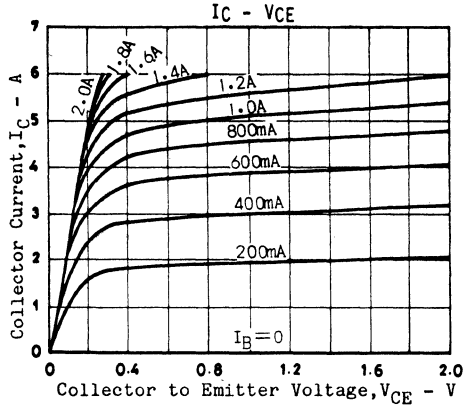
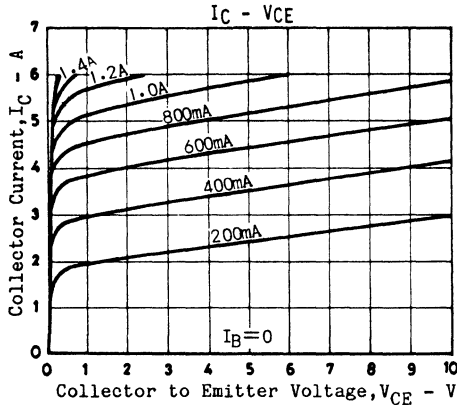
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800V, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5V, I_C=0$			1	mA
DC Current Gain	h_{FE}	$V_{CE}=5V, I_C=1A$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10V, I_C=1A$		3		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=5A, I_B=1A$			5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=5A, I_B=1A$			1.5	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5mA, I_E=0$	1500			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=100mA, R_{BE}=\infty$	800			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=200mA, I_C=0$	7			V
Fall Time	t_f	$I_C=5A, I_{B1}=1A, I_{B2}=-2A$			0.7	μs

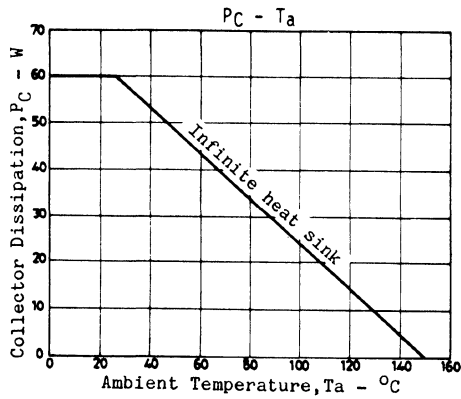
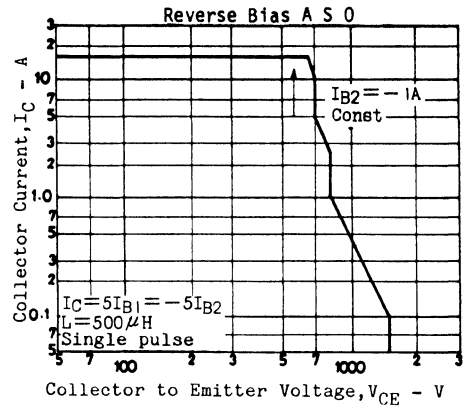
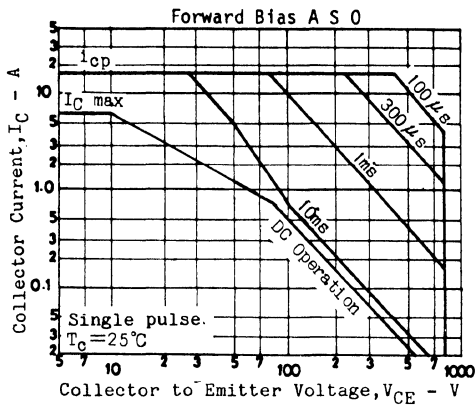
Switching Time Test Circuit



Case Outline 2039 (unit:mm)







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2SK223	958
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2SK333	979
2SK334	982
2SK376	985
2SK377	988
2SK404	991
2SK427	994
2SK436	1000
2SK443	1006
2SK444	1009
2SK445	1012
2SK493	1015
2SK543	1018
2SK544	1019
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2SK546	1023
2SK583	1026
3SK107	1027

**2SK-TYPE
3SK-TYPE
(FET'S)**

All specifications and characteristics shown on the following pages are for standard products. Data shown on individual figures, except P_C derating curve and ASO, are represented by typical values. Ambient temperature T_a is 25°C unless otherwise specified.

2SK41



2005A

N-Channel Junction
Silicon Field-Effect Transistor

FM RF Amp, Converter Applications

Ⓔ331F

Features

- . Stable when used in amp because of small c_{rs} .
- . Large g_m and PG, small NF.
- . Excellent cross modulation characteristics.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Gate to Drain Voltage	V_{GDO}	-18	V
Gate Current	I_G	10	mA
Device Dissipation	P_D	200	mW
Junction Temperature	T_j	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to +125	$^\circ\text{C}$

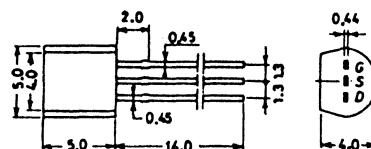
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
G-D Breakdown Voltage	$V_{(BR)GDO}$	$I_G=-100\mu\text{A}$	-18			V
Gate Cutoff Current	I_{GSS}	$V_{GS}=-1.0\text{V}, V_{DS}=0$			-10	nA
Drain Current	I_{DSS}^*	$V_{DS}=10\text{V}, V_{GS}=0$	0.6*		24*	mA
Forward Transfer Admittance	$ y_{fs} $ (1)	$V_{DS}=10\text{V}, V_{GS}=0, f=1\text{kHz}$		7		ms
	$ y_{fs} $ (2)	At specified circuit, $f=100\text{MHz}$	2.0			ms
Power Gain	PG	$V_{DS}=10\text{V}, I_D=3\text{mA}, f=100\text{MHz}$		22		dB
Noise Figure	NF	$V_{DS}=10\text{V}, I_D=3\text{mA}, f=100\text{MHz}$			3.5	dB
Reverse Transfer Capacitance	c_{rs}	$V_{DS}=10\text{V}, V_{GS}=0, f=1\text{MHz}$	0.35	0.75		pF
Cutoff Voltage	$V_{GS(off)}$	$V_{DS}=10\text{V}, I_D=10\mu\text{A}$ [C]	-0.6	-1.2		V
		" " [D]	-0.9	-1.9		V
		" " [E]	-1.4	-3.0		V
		" " [F]	-2.2	-5.0		V
		" " [G]	-3.1			V

* The 2SK41 is classified by I_{DSS} as follows: (unit:mm)

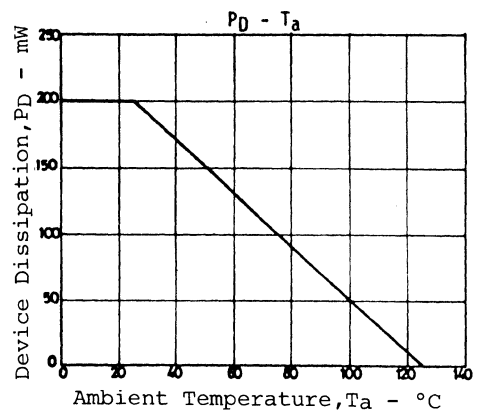
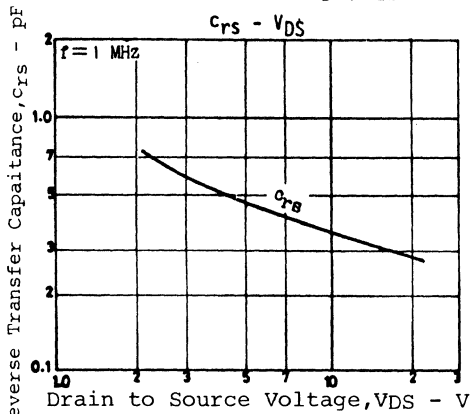
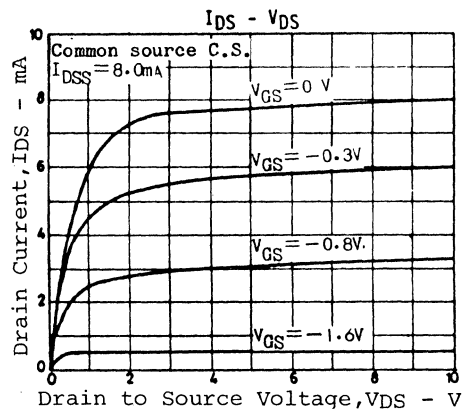
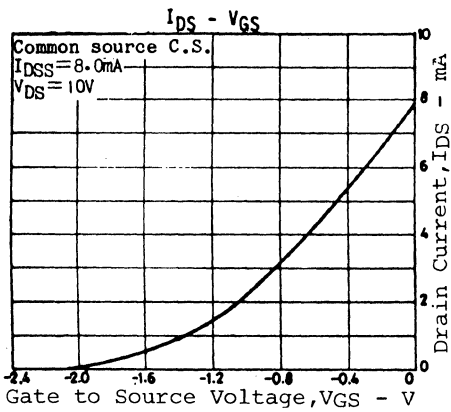
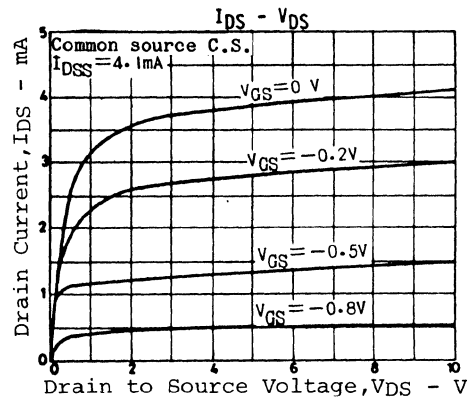
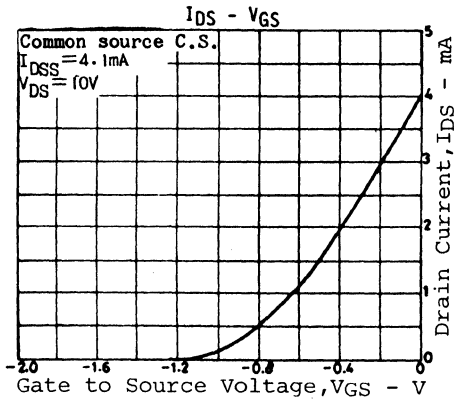
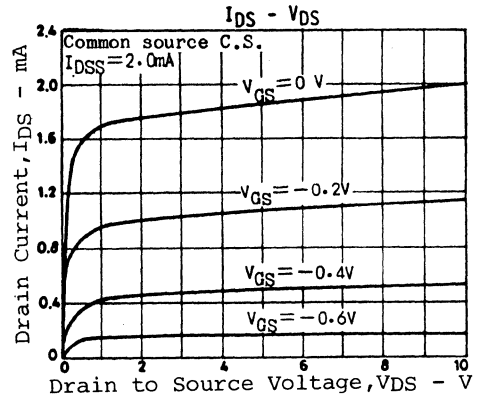
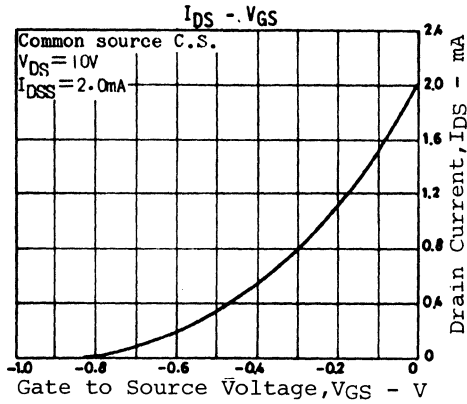
0.6	C	1.5	1.2	D	3.0	2.5	E	6.0	5.0	F	12	10	G	24
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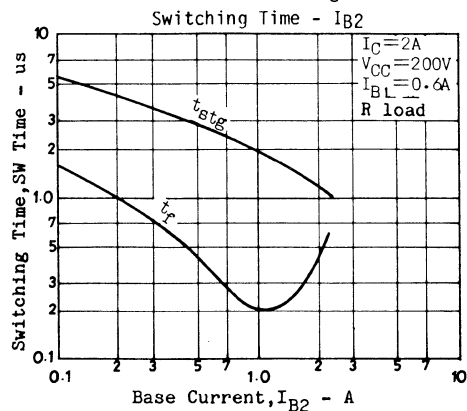
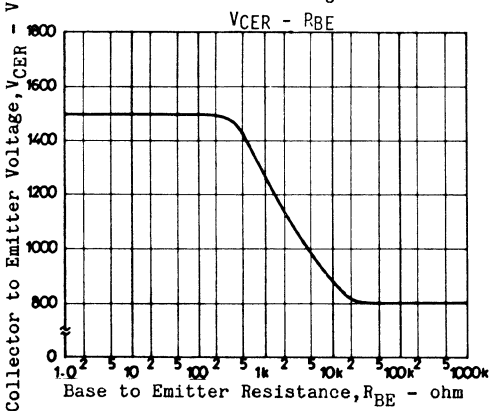
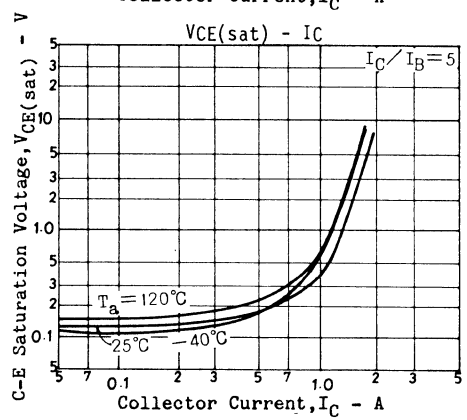
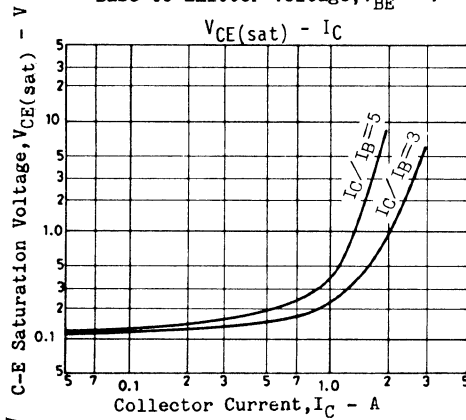
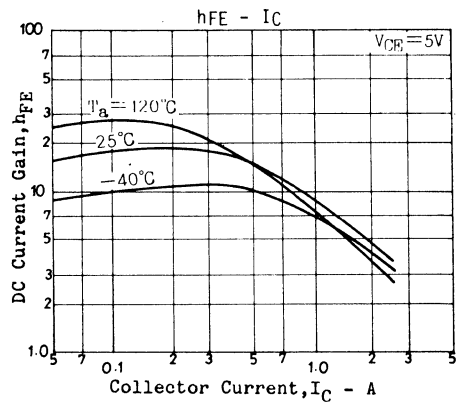
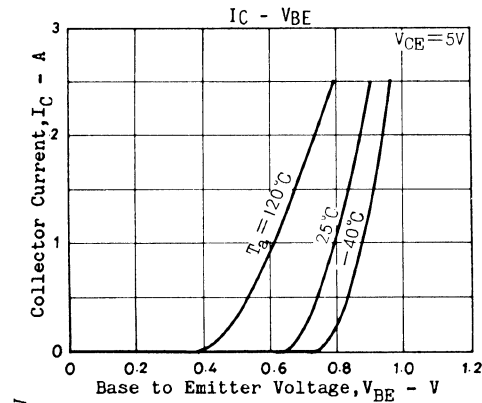
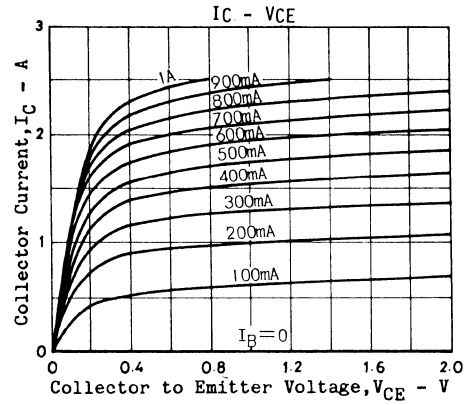
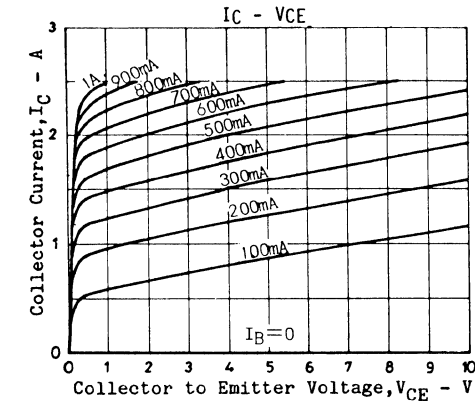
Case Outline 2005A (unit:mm)

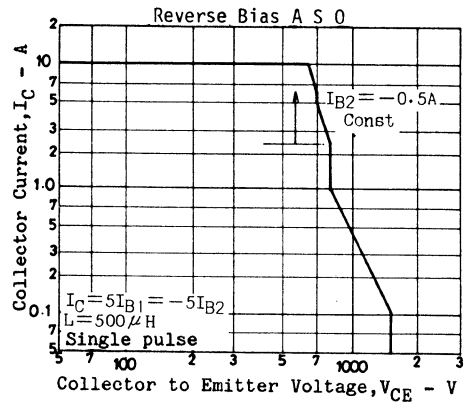
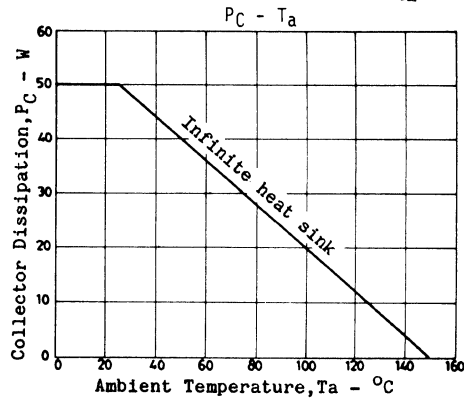
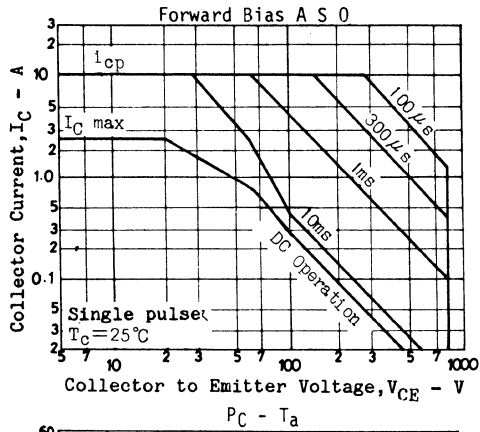


JEDEC: TO-92
EIAJ : SC-43
SANYO: NP

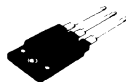
G: Gate
S: Source
D: Drain







2SD1654



2039

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications (with Damper Diode)

©1752

Applications

- High-voltage, power switching

Features

- Fast speed (t_f max=0.7us).
- High reliability (Adoption of HVP process).
- High breakdown voltage (V_{CBO} =1500V).
- Micaless package facilitating mounting operation.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

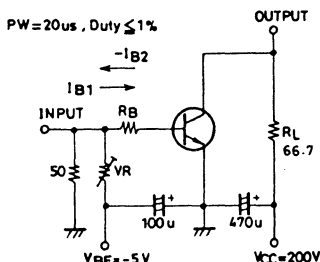
			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	3.5	A
Peak Collector Current	i_{cp}	10	A
Collector Dissipation	P_C	50	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

$T_C=25^\circ\text{C}$

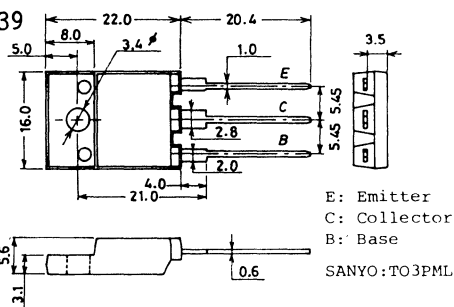
Electrical Characteristics at $T_a=25^\circ\text{C}$

			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{CB}=800\text{V}, I_E=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{EB}=5\text{V}, I_C=0$			1	mA
DC Current Gain	h_{FE}	$V_{CE}=5\text{V}, I_C=0.5\text{A}$	8			
Gain Bandwidth Product	f_T	$V_{CE}=10\text{V}, I_C=0.5\text{A}$		3		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=2.5\text{A}, I_B=0.8\text{A}$			8	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C=2.5\text{A}, I_B=0.8\text{A}$			1.5	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C=5\text{mA}, I_E=0$	1500			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C=100\text{mA}, R_{BE}=\infty$	800			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E=200\text{mA}, I_C=0$	7			V
Fall Time	t_f	$I_C=3\text{A}, I_{B1}=0.8\text{A}, I_{B2}=-1.6\text{A}$			0.7	us

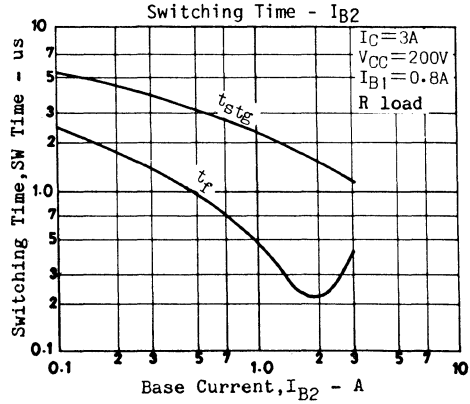
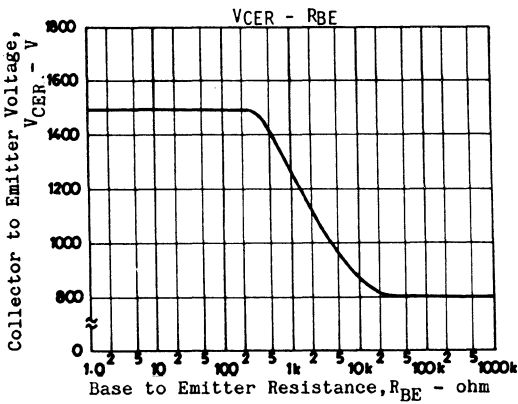
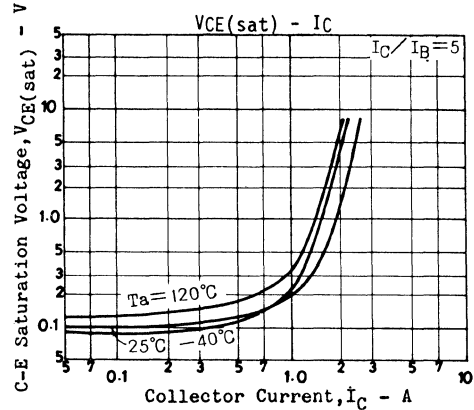
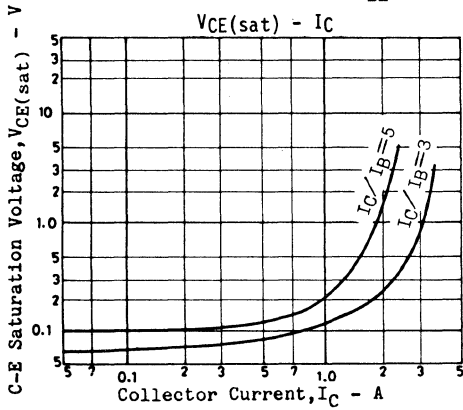
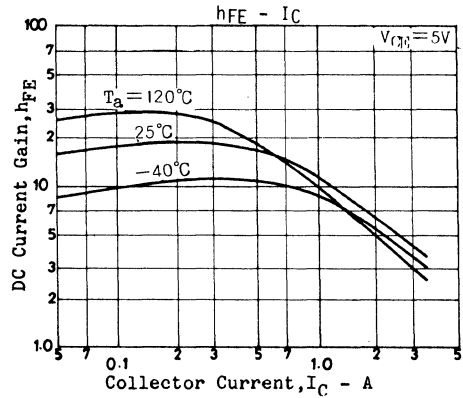
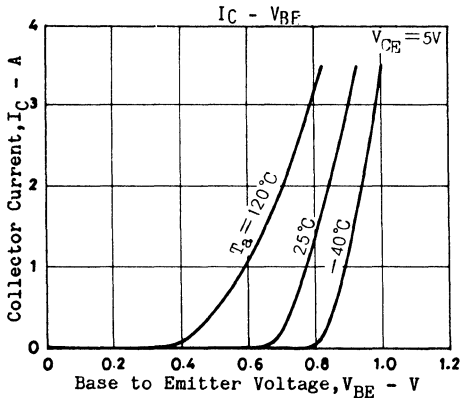
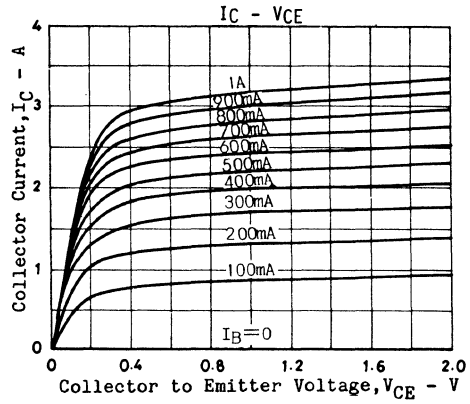
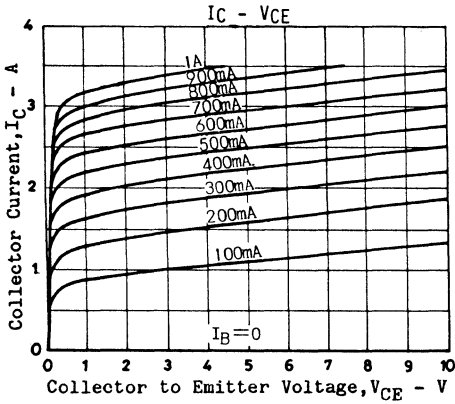
Switching Time Test Circuit

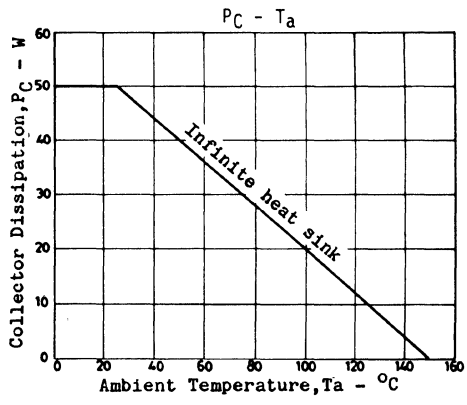
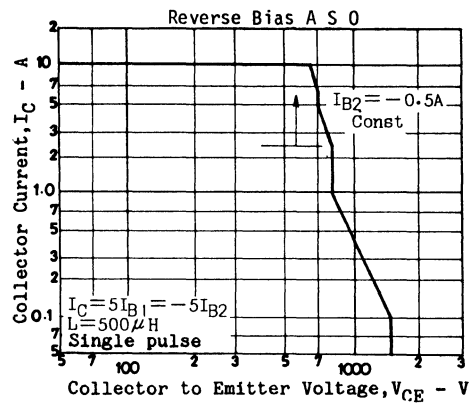
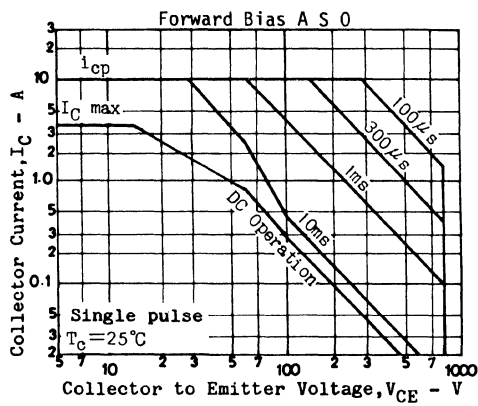


Case Outline 2039 (unit:mm)

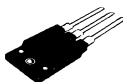


D244KI, TS No.1752-1/3





2SD1655



2039

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications (with Damper Diode)

©1753

Applications

- High-voltage, power switching

Features

- Fast speed ($t_{r,max}=0.7\mu s$).
- High reliability (Adoption of HVP process).
- High breakdown voltage ($V_{CBO}=1500V$).
- Micaless package facilitating mounting operation.

Absolute Maximum Ratings at $T_a=25^\circ C$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_C	5	A
Peak Collector Current	i_{cp}	16	A
Collector Dissipation	P_C	60	W
Junction Temperature	T_j	150	$^\circ C$
Storage Temperature	T_{stg}	-55 to +150	$^\circ C$

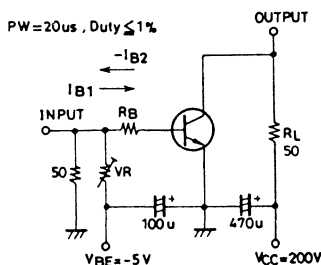
$T_C=25^\circ C$

Electrical Characteristics at $T_a=25^\circ C$

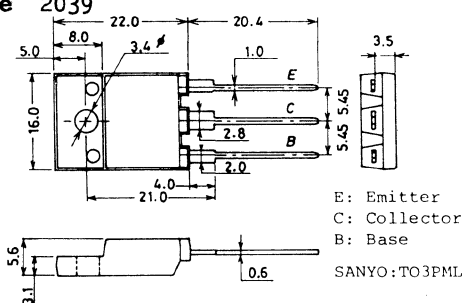
		min	typ	max	unit
Collector Cutoff Current	I_{CBO}			10	μA
Emitter Cutoff Current	I_{EBO}			1	mA
DC Current Gain	h_{FE}	8			
Gain Bandwidth Product	f_T		3		MHz
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$			5	V
Base to Emitter Saturation Voltage	$V_{BE(sat)}$			1.5	V
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	1500			V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	800			V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	7			V
Fall Time	t_f			0.7	μs

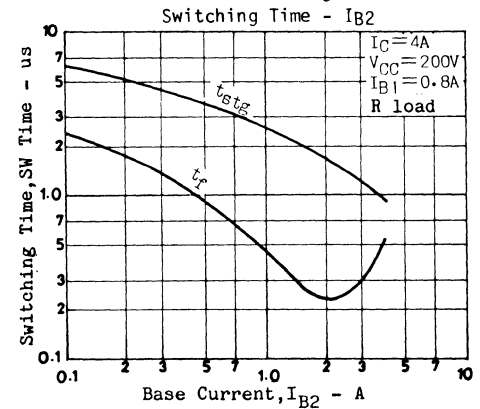
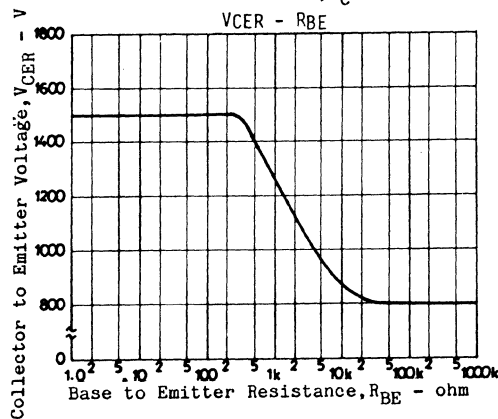
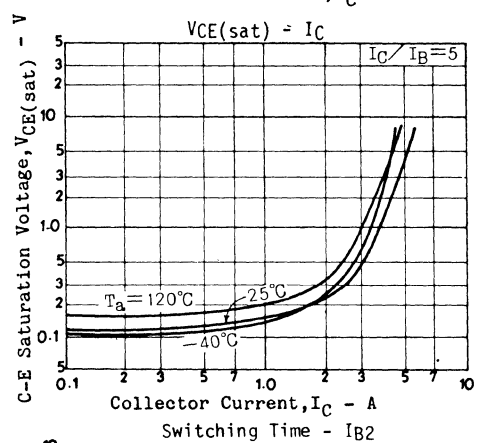
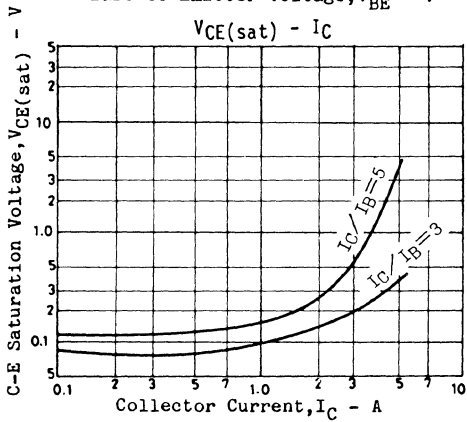
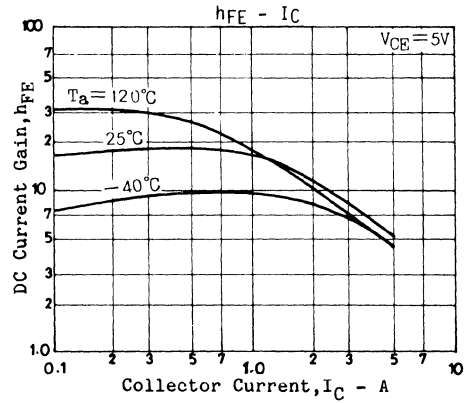
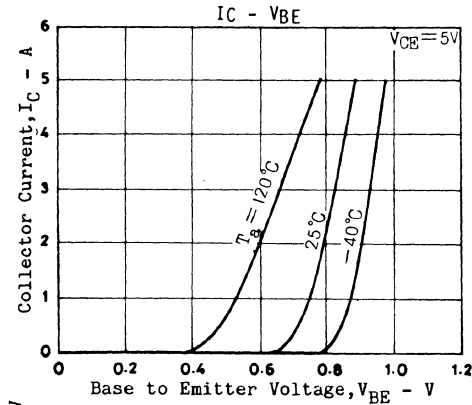
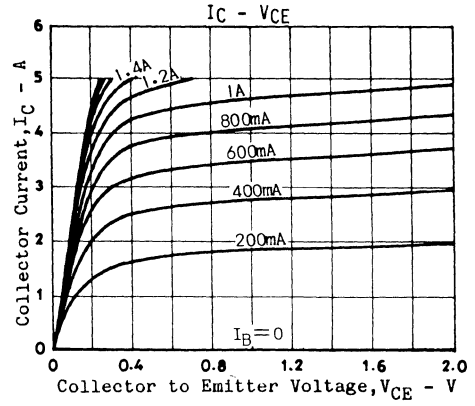
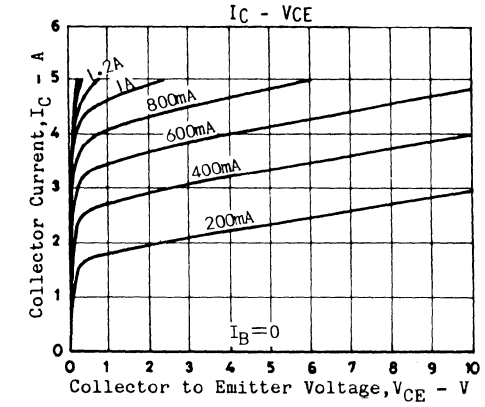
$I_C=4A, I_{B1}=0.8A,$
 $I_{B2}=-1.6A$

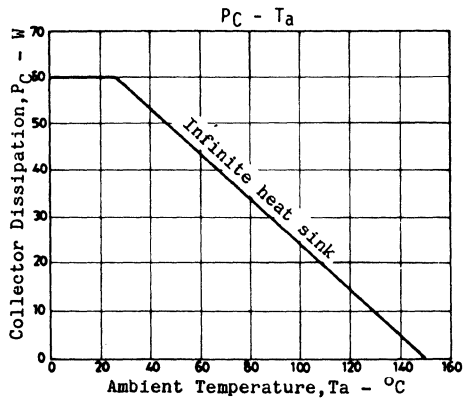
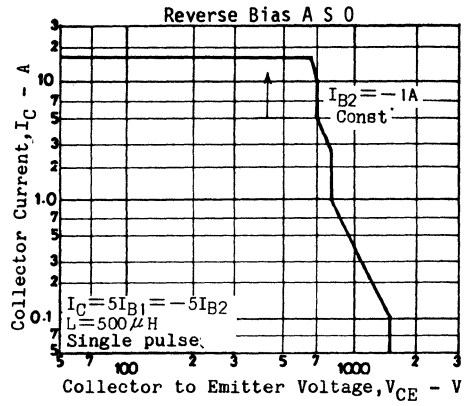
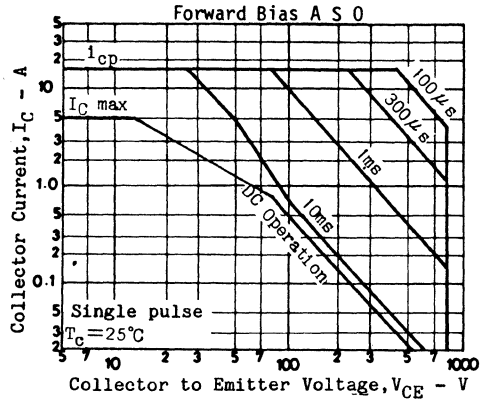
Switching Time Test Circuit



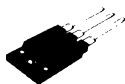
Case Outline 2039 (unit:mm)







2SD1656



2039

NPN Triple Diffused Planar
Silicon Transistor

Color TV Horizontal Deflection Output Applications (with Damper Diode)

©1754

Applications

- High-voltage, power switching

Features

- Fast speed ($t_{\text{max}}=0.7\mu\text{s}$).
- High reliability (Adoption of HVP process).
- High breakdown voltage ($V_{\text{CBO}}=1500\text{V}$).
- Micaless package facilitating mounting operation.

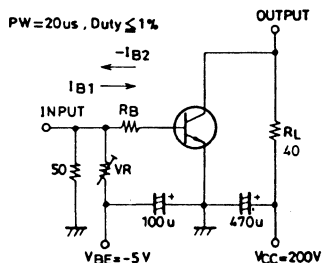
Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Collector to Base Voltage	V_{CBO}	1500	V
Collector to Emitter Voltage	V_{CEO}	800	V
Emitter to Base Voltage	V_{EBO}	6	V
Collector Current	I_{C}	6	A
Peak Collector Current	i_{cp}	16	A
Collector Dissipation	P_{C}	60	W
Junction Temperature	T_{j}	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

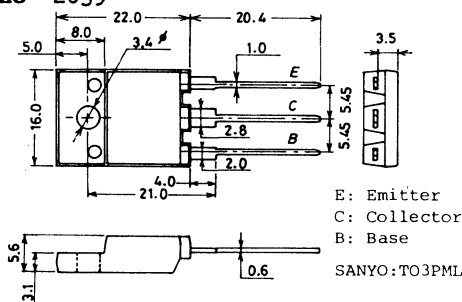
Electrical Characteristics at $T_a=25^\circ\text{C}$

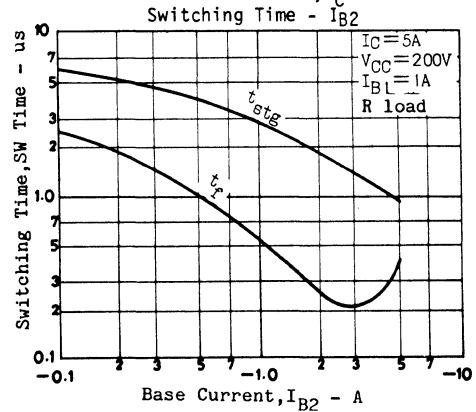
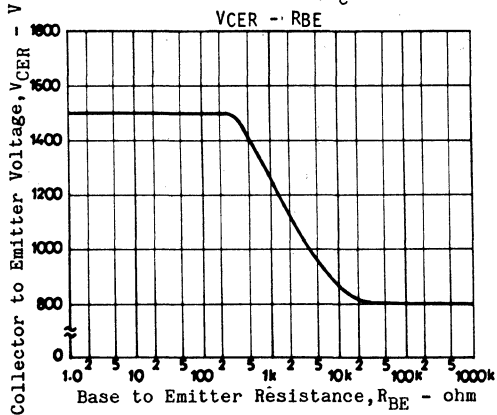
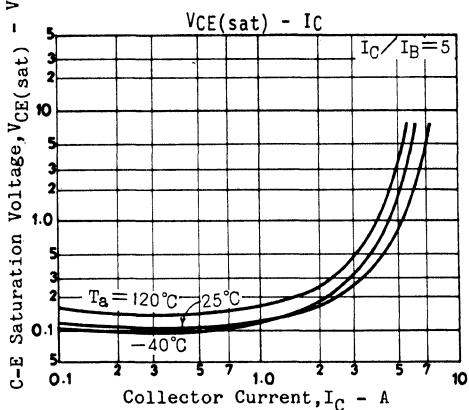
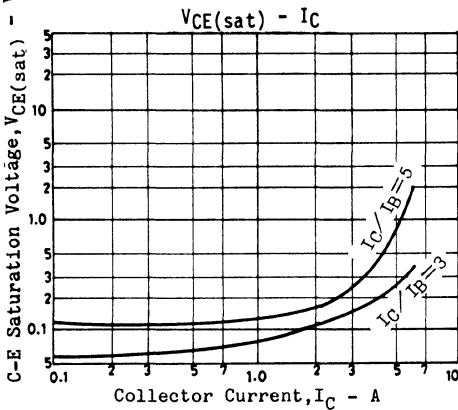
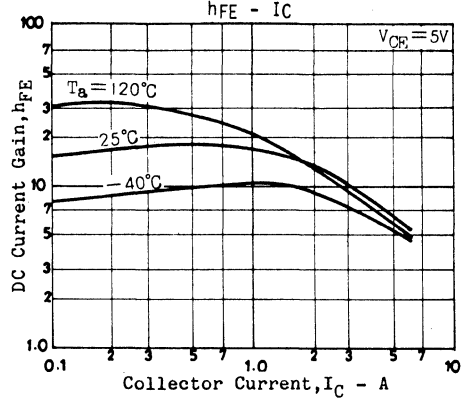
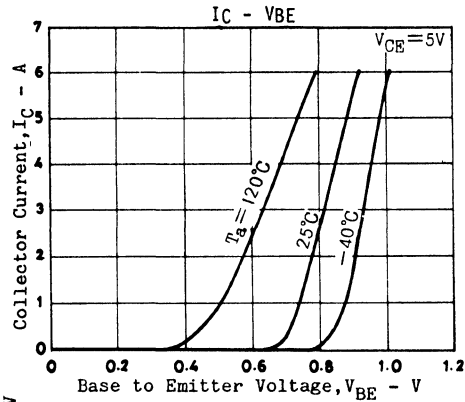
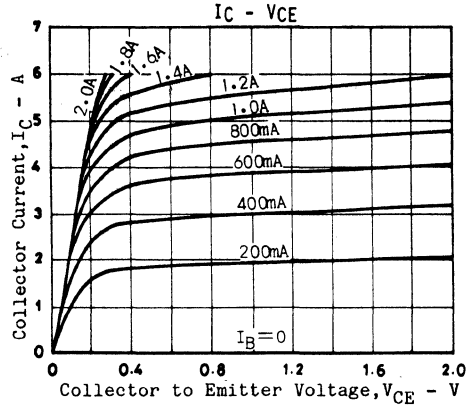
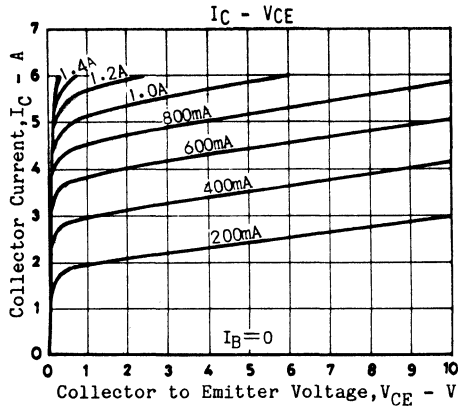
			min	typ	max	unit
Collector Cutoff Current	I_{CBO}	$V_{\text{CB}}=800\text{V}, I_{\text{E}}=0$			10	μA
Emitter Cutoff Current	I_{EBO}	$V_{\text{EB}}=5\text{V}, I_{\text{C}}=0$			1	mA
DC Current Gain	h_{FE}	$V_{\text{CE}}=5\text{V}, I_{\text{C}}=1\text{A}$	8			
Gain Bandwidth Product	f_{T}	$V_{\text{CE}}=10\text{V}, I_{\text{C}}=1\text{A}$		3		MHz
Collector to Emitter Saturation Voltage	$V_{\text{CE(sat)}}$	$I_{\text{C}}=5\text{A}, I_{\text{B}}=1\text{A}$			5	V
Base to Emitter Saturation Voltage	$V_{\text{BE(sat)}}$	$I_{\text{C}}=5\text{A}, I_{\text{B}}=1\text{A}$			1.5	V
Collector to Base Breakdown Voltage	$V_{\text{(BR)CBO}}$	$I_{\text{C}}=5\text{mA}, I_{\text{E}}=0$	1500			V
Collector to Emitter Breakdown Voltage	$V_{\text{(BR)CEO}}$	$I_{\text{C}}=100\text{mA}, R_{\text{BE}}=\infty$	800			V
Emitter to Base Breakdown Voltage	$V_{\text{(BR)EBO}}$	$I_{\text{E}}=200\text{mA}, I_{\text{C}}=0$	7			V
Fall Time	t_{f}	$I_{\text{C}}=5\text{A}, I_{\text{B1}}=1\text{A}, I_{\text{B2}}=-2\text{A}$			0.7	μs

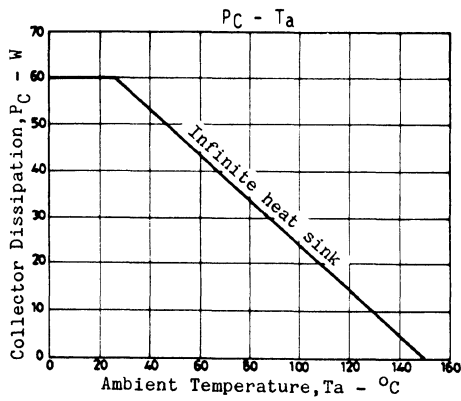
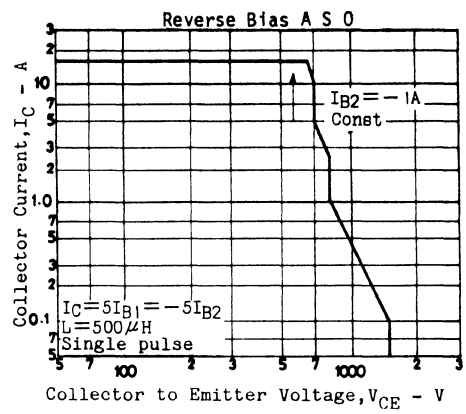
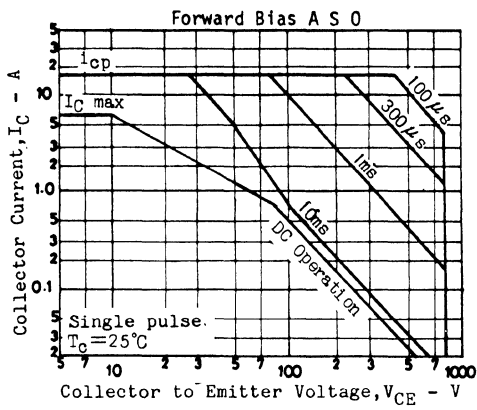
Switching Time Test Circuit



Case Outline 2039 (unit:mm)







	Page
2SK41	943
2SK156	949
2SK212	952
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2SK223	958
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2SK304	970
2SK315	972
2SK332	976
2SK333	979
2SK334	982
2SK376	985
2SK377	988
2SK404	991
2SK427	994
2SK436	1000
2SK443	1006
2SK444	1009
2SK445	1012
2SK493	1015
2SK543	1018
2SK544	1019
2SK545	1020
2SK546	1023
2SK583	1026
3SK107	1027

**2SK-TYPE
3SK-TYPE
(FET'S)**

All specifications and characteristics shown on the following pages are for standard products. Data shown on individual figures, except P_C derating curve and ASO, are represented by typical values. Ambient temperature T_a is 25°C unless otherwise specified.

2SK41



2005A

N-Channel Junction
Silicon Field-Effect Transistor

FM RF Amp, Converter Applications

©331F

Features

- . Stable when used in amp because of small c_{rs} .
- . Large g_m and PG, small NF.
- . Excellent cross modulation characteristics.

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Gate to Drain Voltage	V_{GDO}	-18	V
Gate Current	I_G	10	mA
Device Dissipation	P_D	200	mW
Junction Temperature	T_j	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to +125	$^\circ\text{C}$

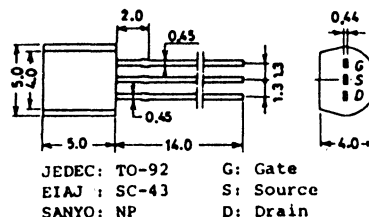
Electrical Characteristics at $T_a=25^\circ\text{C}$

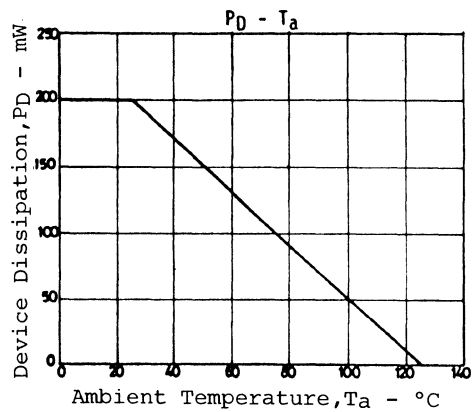
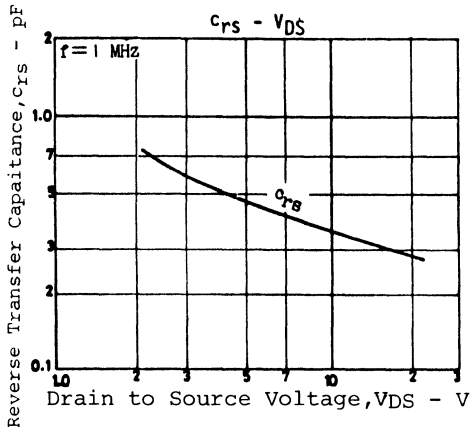
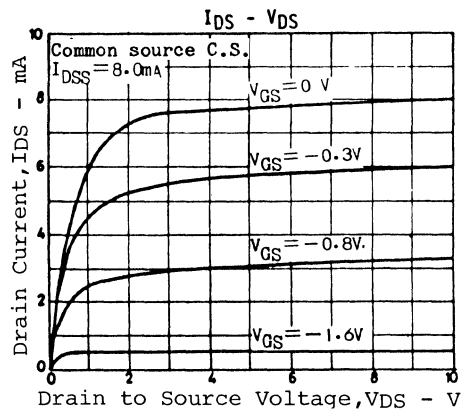
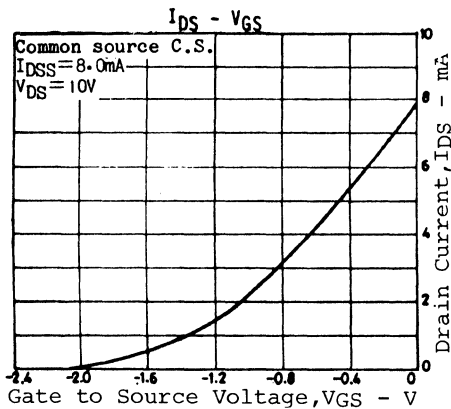
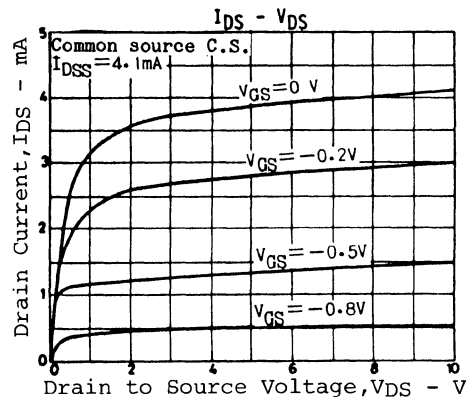
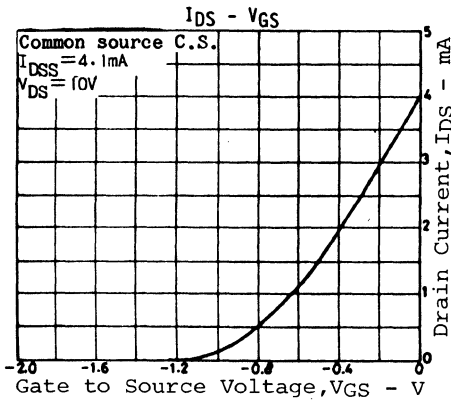
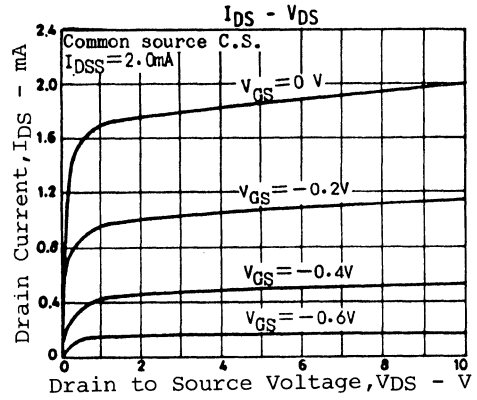
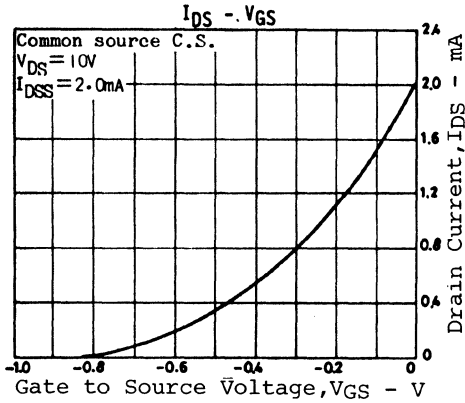
			min	typ	max	unit
G-D Breakdown Voltage	$V_{(BR)GDO}$	$I_G=-100\mu\text{A}$	-18			V
Gate Cutoff Current	I_{GSS}	$V_{GS}=-1.0\text{V}, V_{DS}=0$			-10	nA
Drain Current	I_{DSS}	$V_{DS}=10\text{V}, V_{GS}=0$	0.6*		24*	mA
Forward Transfer Admittance	$ y_{fs} $	(1) $V_{DS}=10\text{V}, V_{GS}=0, f=1\text{kHz}$		7		ms
	$ y_{fs} $	(2) At specified circuit, $f=100\text{MHz}$	2.0			ms
Power Gain	PG	$V_{DS}=10\text{V}, I_D=3\text{mA}, f=100\text{MHz}$		22		dB
Noise Figure	NF	$V_{DS}=10\text{V}, I_D=3\text{mA}, f=100\text{MHz}$			3.5	dB
Reverse Transfer Capacitance	c_{rs}	$V_{DS}=10\text{V}, V_{GS}=0, f=1\text{MHz}$	0.35	0.75		pF
Cutoff Voltage	$V_{GS(off)}$	$V_{DS}=10\text{V}, I_D=10\mu\text{A}$ [C]	-0.6	-1.2		V
		[D]	-0.9	-1.9		V
		[E]	-1.4	-3.0		V
		[F]	-2.2	-5.0		V
		[G]	-3.1			V

* The 2SK41 is classified by I_{DSS} as follows: (unit:mm)

0.6	C	1.5	1.2	D	3.0	2.5	E	6.0	5.0	F	12	10	G	24
-----	---	-----	-----	---	-----	-----	---	-----	-----	---	----	----	---	----

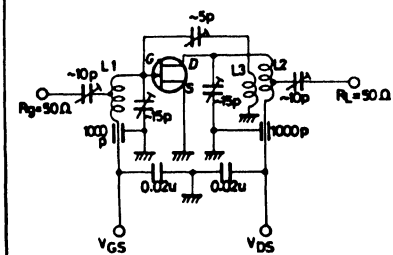
Case Outline 2005A (unit:mm)





Test Circuit

100 MHz PG, NF TEST CIRCUIT



Coil Data

(Coil Data)

L1: 5T,Center tap:4T from
cold end

L2: 7T, Center tap: 4T from cold end

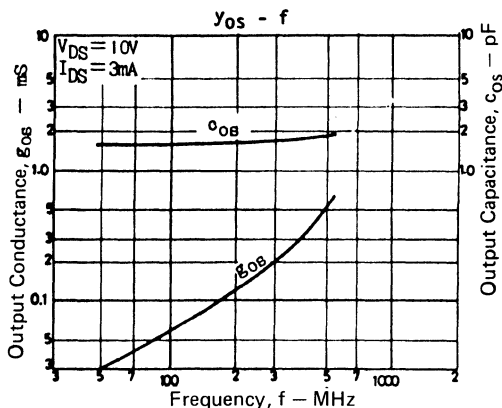
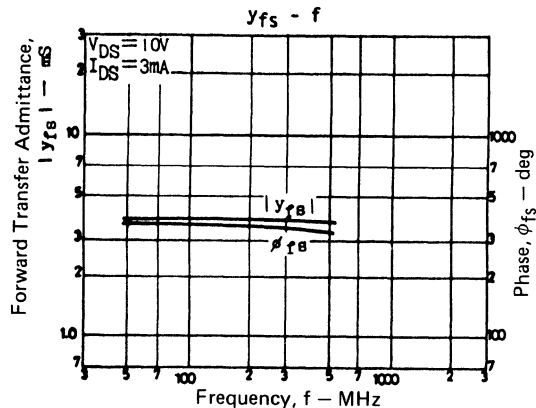
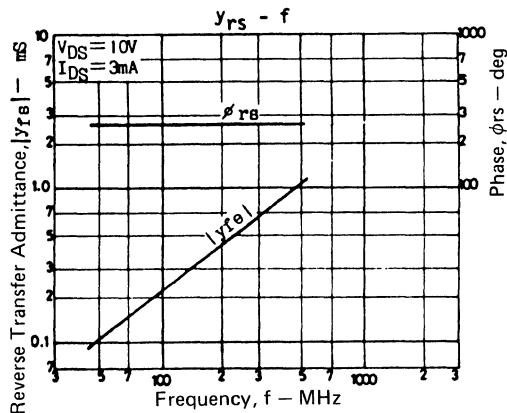
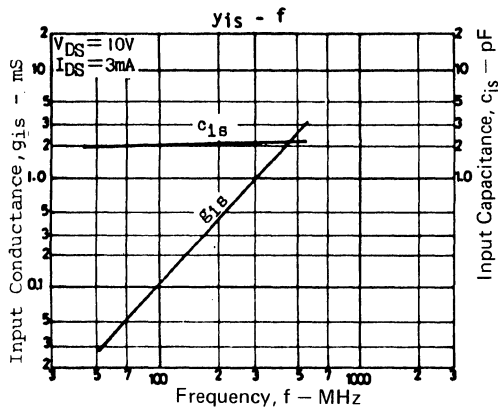
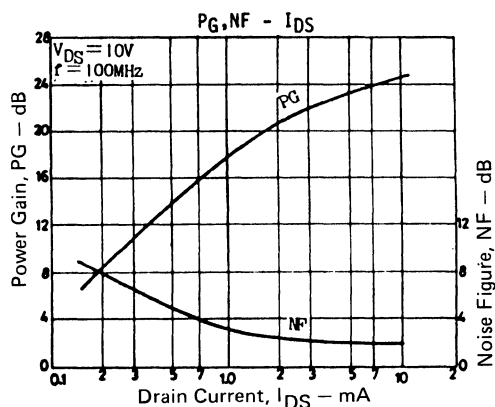
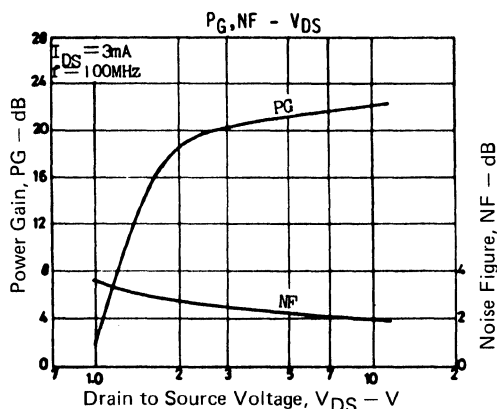
L3: 3 1/2 turns

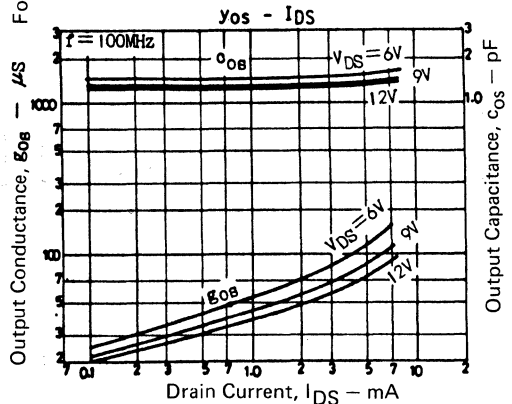
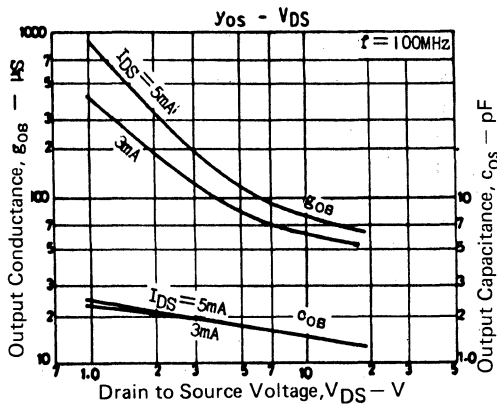
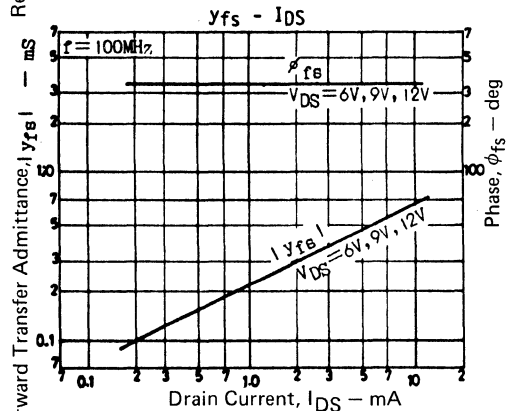
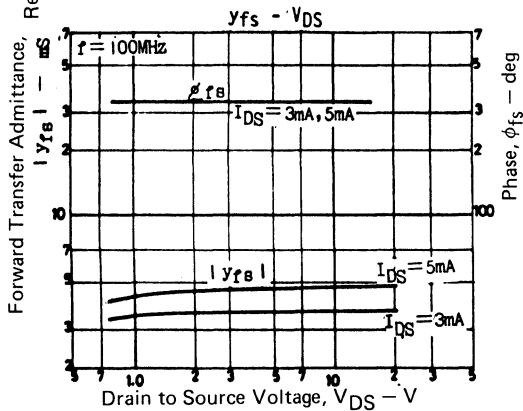
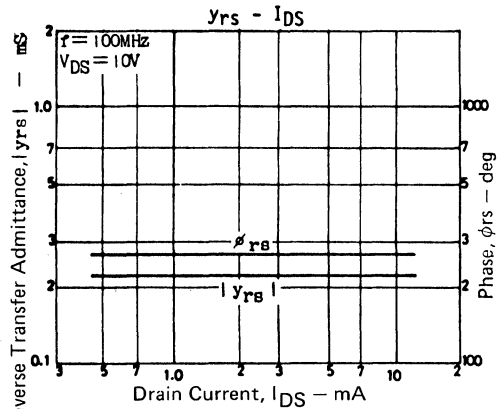
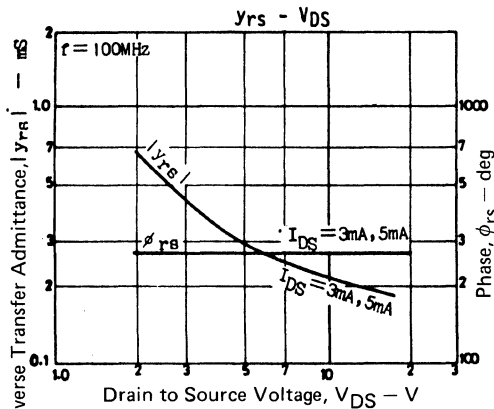
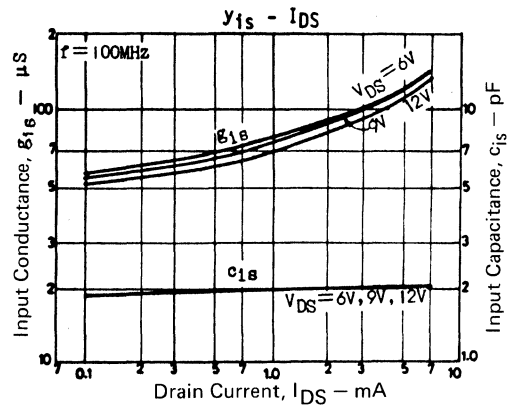
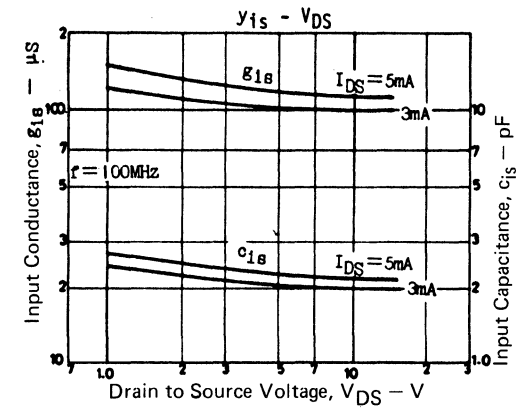
Wire diameter: 1.0mm ϕ

Wire L1,L2: Sn-plated wire

L3 : Enameled wire

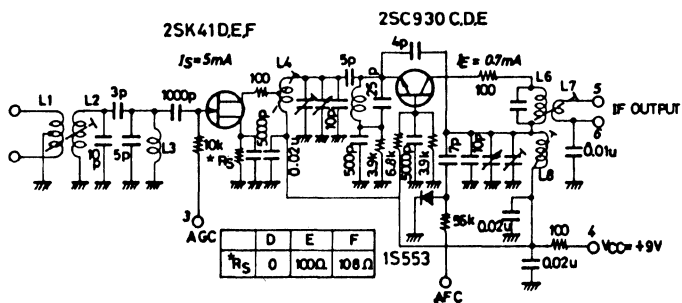
Coil inside diameter: 10mmø





Sample Application 1. FM Tuner/2-gang 2-pc., 3-gang 3-pc.**Characteristics**

		2-gang 2-pc.	3-gang 3-pc.
Receiving frequency range		87~109 MHz	87~109 MHz
Antenna input impedance		300 Ω	300 Ω
IF output impedance		300 Ω	300 Ω
Supply voltage		9 V dc	9 V dc
Main characteristics	Measured frequency		
	Power gain	88 MHz 98 MHz 108 MHz	18.0 dB 21.0 dB 17.0 dB
	Noise figure	88 MHz 98 MHz 108 MHz	23.0 dB 24.0 dB 23.0 dB
	Image rejection ratio	108 MHz	12.0 dB 5.5 dB
	IF rejection ratio	88 MHz	10.0 dB 5.0 dB
	Input at 1% cross modulation	108 MHz	12.0 dB 5.0 dB
	AGC-FOM		34.0 dB 41.0 dB
	Local OSC voltage	88 MHz	57.0 dB 80.0 dB
	AFC characteristics	98 MHz	82.0 dB (max) 81.0 dB (max)
			27.0 dB 23.5 dB
		103~130 mV	50~90 mV
		+180, -300kHz	+150, -300kHz

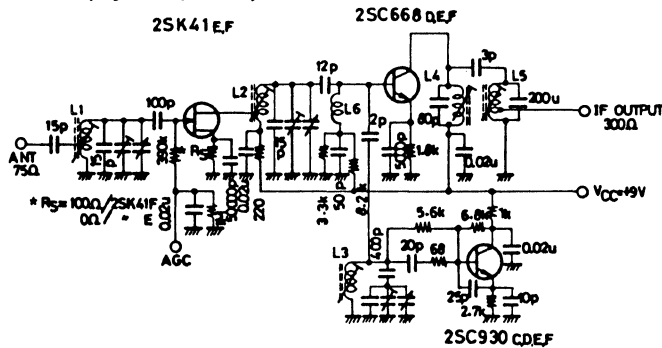
(A) 2-gang 2-pc.

Sample Application 2. Police band tuner/29 to 56MHz, 130 to 160MHz.

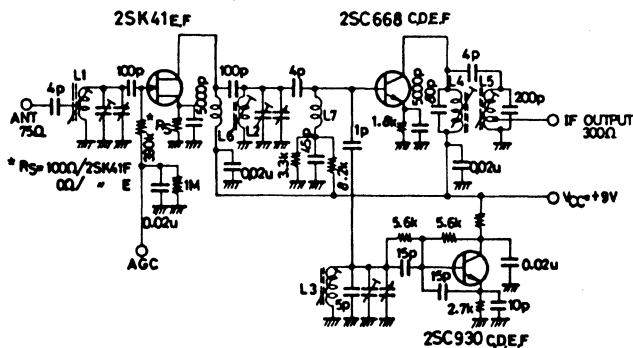
Characteristics

Receiving frequency range		29 to 56 MHz		130 to 160 MHz	
Antenna input impedance		75 Ω		75 Ω	
IF output impedance		300 Ω		300 Ω	
Supply voltage		9 Vdc		9 Vdc	
Main characteristics		Measured frequency		Measured frequency	
	Power gain	30 MHz	33.5 dB	138 MHz	28.0 dB
		42 MHz	37.0 dB	148 MHz	28.0 dB
		55 MHz	37.0 dB	158 MHz	27.5 dB
	Noise figure	30 MHz	8.2 dB	138 MHz	5.8 dB
		42 MHz	5.3 dB	148 MHz	5.5 dB
		55 MHz	5.3 dB	158 MHz	7.0 dB
	Image rejection ratio	55 MHz	44.0 dB	158 MHz	45.0 dB
	IF rejection ratio	30 MHz	104.2 dB	138 MHz	90.0 dB
	1/2 IF rejection ratio	55 MHz	70.0 dB	158 MHz	67.0 dB
Input at 1% cross modulation	50 $\pm$ 2 MHz	84.0, 78.5 dB	158 $\pm$ 2 MHz	75, 70 dB	
AGC-FOM	42 MHz	32.0 dB (max)	148 MHz	41.0 dB (max)	

(A) Police band (29 to 56MHz) tuner



(B) Police band (130 to 160MHz) tuner



2SK156



2037

N-Channel Junction
Silicon Field-Effect Transistor

Capacitor Microphone Impedance Conversion Applications

©540E

ABSOLUTE MAXIMUM RATINGS/ $T_a = 25^\circ\text{C}$

			unit
Gate drain voltage	V_{DGO}	-20	V
Gate current	I_G	10	mA
Allowable power dissipation	P_D	100	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage ambient temperature	T_{stg}	-40 ~ +125	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Drain current	I_{DSS}^*	$V_{DS} = 10\text{ V}, V_{GS} = 0$	60		800	μA

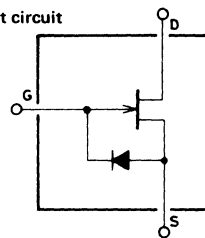
[$T_a = 25^\circ\text{C}$, $V_{CC} = 4.5\text{ V}$, $R_D = 680\ \Omega$, $C_{in} = 15\text{ pF}$, in specified test circuit (conforming with application circuit)]

			min	typ	max	unit
Transmission loss	G_V	$V_{in} = 10\text{ mV}, f = 1\text{ kHz}$		-5		dB
Voltage-drop characteristic of transmission loss	ΔG_{VV}	$V_{CC} = 4.5 \sim 1.5\text{ V}, f = 1\text{ kHz}, V_{in} = 10\text{ mV}$			-3	dB
Frequency characteristic of transmission loss	ΔG_{Vf}	$f = 1\text{ k} \sim 110\text{ Hz}, V_{in} = 10\text{ mV}$			-1	dB
Input impedance	z_{in}	$f = 1\text{ kHz}$	20			$\text{M}\Omega$
Output noise voltage	V_{NO}	$V_{in} = 0, A\text{-curve}$			-110	dB

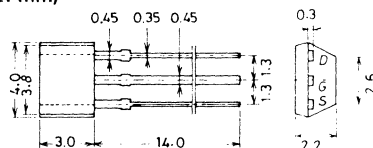
* The 2SK156 is graded as follows by drain current I_{DSS} :

60	J	180	150	K	300	250	L	450	400	M	800
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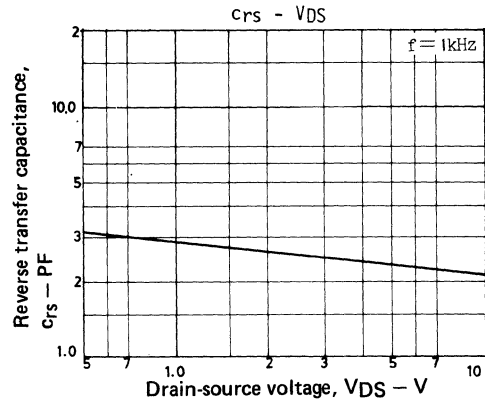
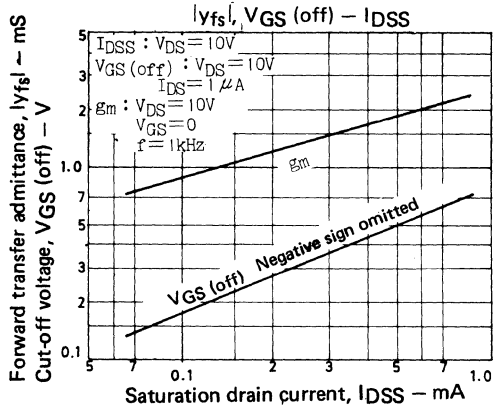
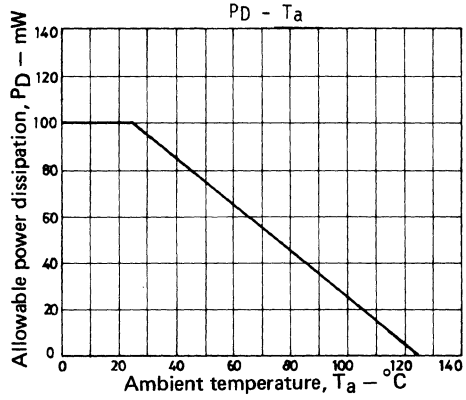
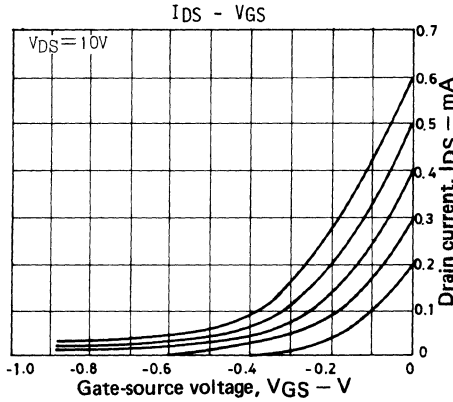
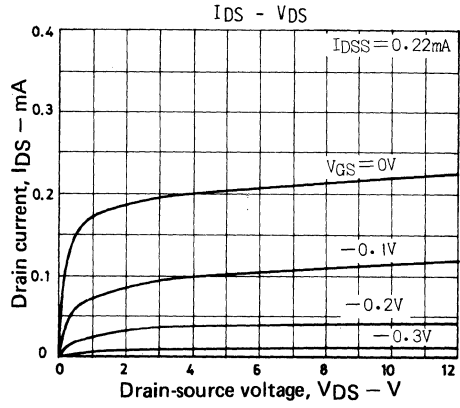
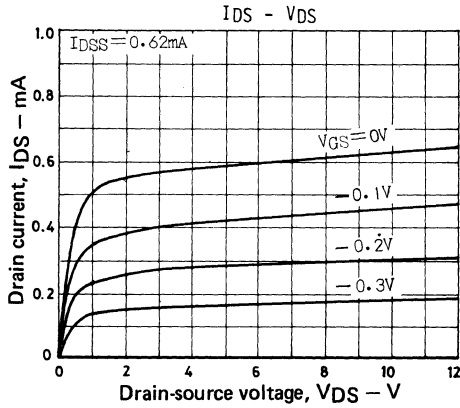
Equivalent circuit



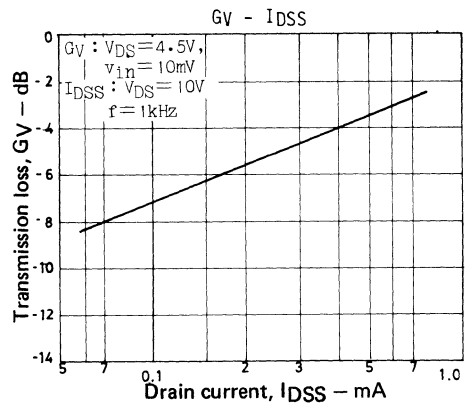
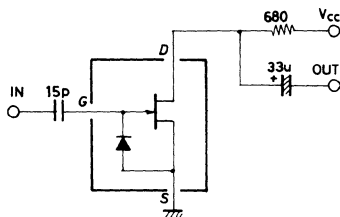
Case Outline 2037
(unit: mm)

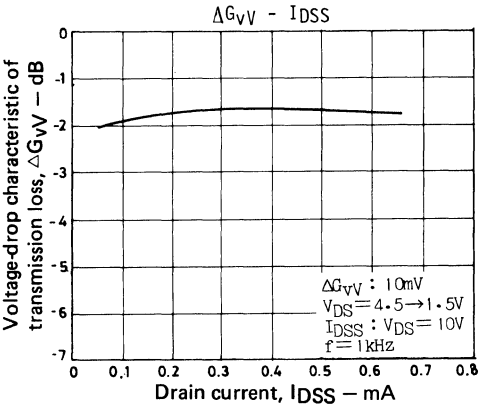
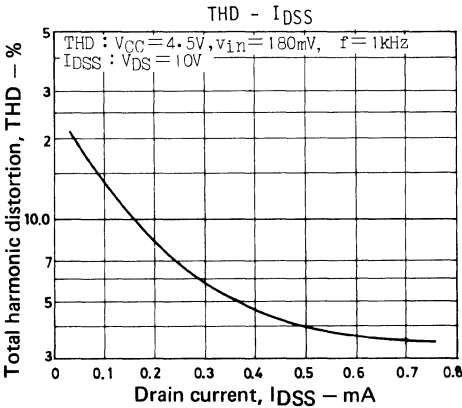


D: Drain
G: Gate
S: Source
SANYO: SP



■ Sample application circuit: 2-wire system





2SK212



2002B

N-Channel Junction
Silicon Field-Effect Transistor

FM Tuner Applications

©661C

FEATURES

- * Ideal for FM tuners in low voltage radios, car radios, etc.
- * Because it is compactly packaged, sets can be made compact.
- * Small c_{rss} ($c_{rss} = 0.04$ pF typ).
- * High $|y_{fs}|$ ($|y_{fs}| = 6.0$ mS typ).

ABSOLUTE MAXIMUM RATINGS/ $T_a = 25^\circ\text{C}$

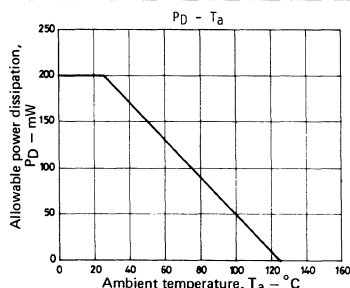
			unit
Gate-drain voltage	V_{GDO}	-20	V
Gate current	I_G	10	mA
Drain current	I_D	20	mA
Allowable power dissipation	P_D	200	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage ambient temperature	T_{stg}	-55 ~ +125	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS/ $T_a = 25^\circ\text{C}$

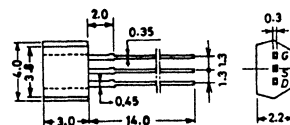
			min	typ	max	unit
Gate-drain breakdown voltage	$V_{(BR)} GDO$	$I_G = -10 \mu\text{A}$	-20			V
Gate cut-off current	I_{GSS}	$V_{GS} = -0.5 \text{ V}, V_{DS} = 0 \text{ V}$			-10	nA
Drain current	I_{DSS}	$V_{DS} = 5 \text{ V}, V_{GS} = 0 \text{ V}$	0.6		12.0	mA
Cut-off voltage	$V_{GS}(\text{off})$	$V_{DS} = 5 \text{ V}, I_D = 10 \mu\text{A}$			-2.5	V
Forward transmission admittance	$ y_{fs} (1)$	$V_{DS} = 5 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ kHz}$	2.0	6.0		mS
Forward transmission admittance	$ y_{fs} (2)$	$V_{DS} = 5 \text{ V}, V_{GS} = 0 \text{ V}, f = 100 \text{ MHz}$	2.0	6.0		mS
Input capacitance	c_{iss}	$V_{DS} = 5 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$		4.0		pF
Feedback capacitance	c_{rss}	$V_{DS} = 5 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$		0.04	0.15	pF
Output capacitance	c_{oss}	$V_{DS} = 5 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$		4.0		pF
Power again	PG	$V_{DS} = 5 \text{ V}, V_{GS} = 0 \text{ V}, f = 100 \text{ MHz}$		21		dB
		Refer to specified test circuit				
Noise figure	NF	Refer to specified test circuit		3.5	6.0	dB

* 2SK212 is graded as follows by I_{DSS} : (unit: mA).

0.6	C	1.5	1.2	D	3.0	2.5	E	6.0	5.0	F	12.0
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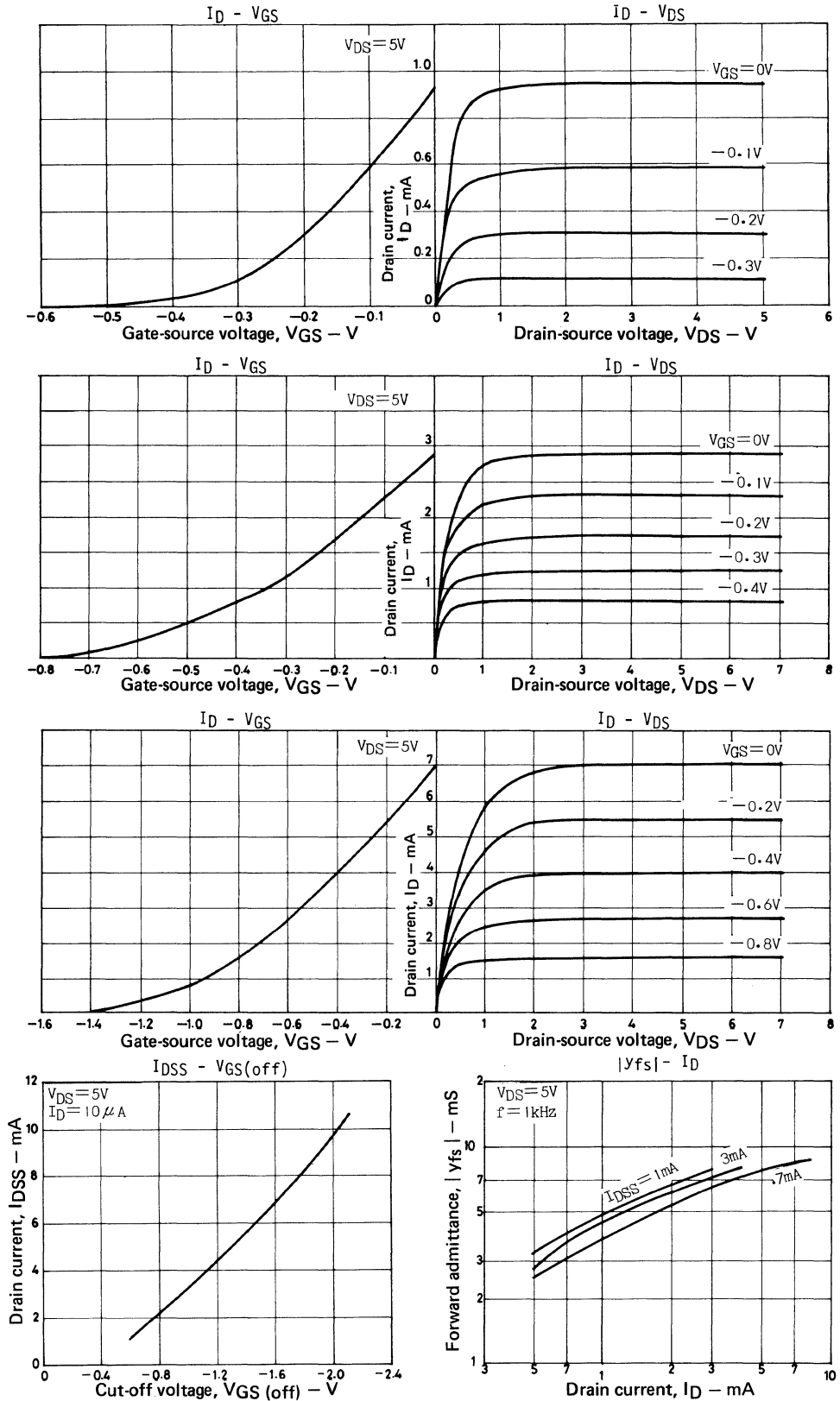
Case Outline 2002B
(unit:mm)

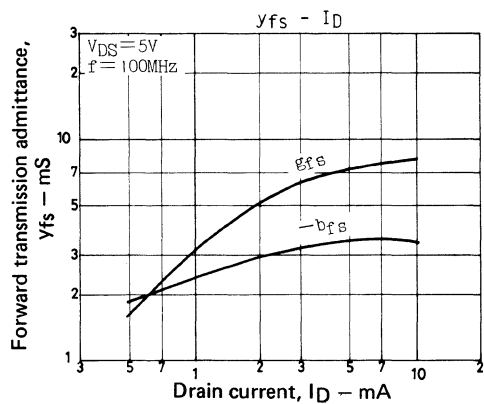
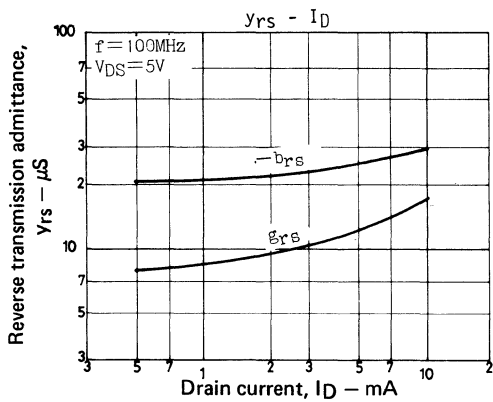
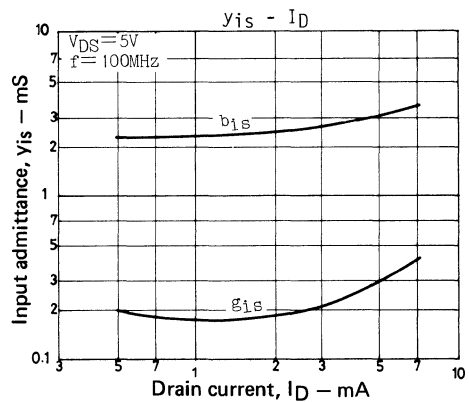
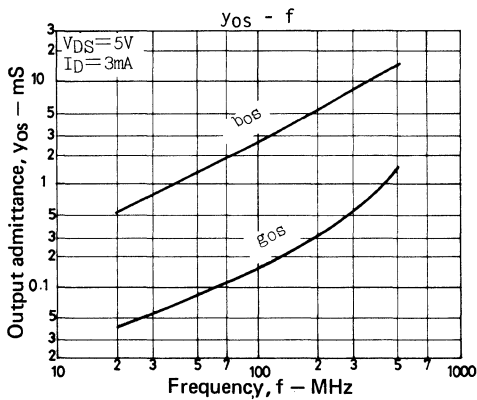
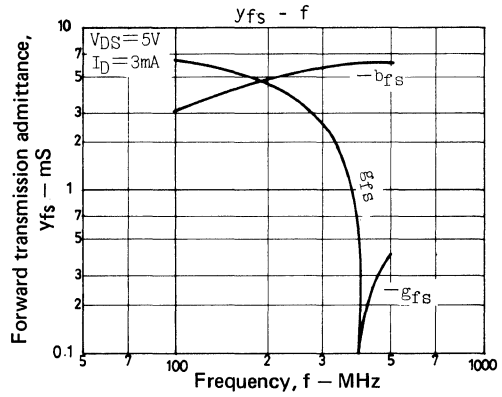
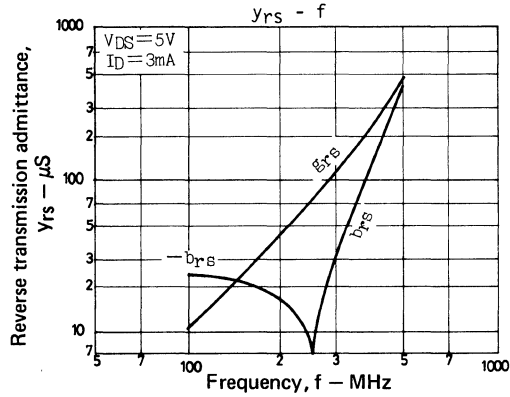
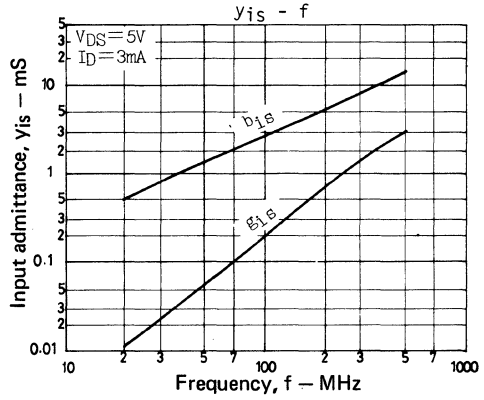
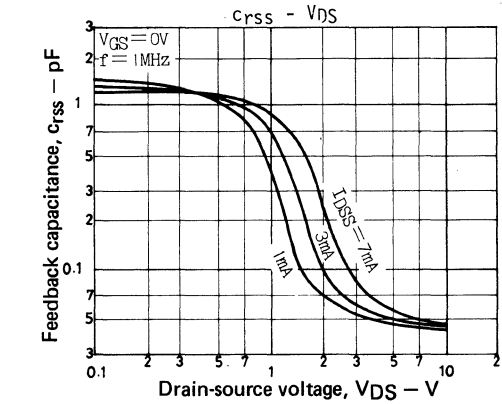


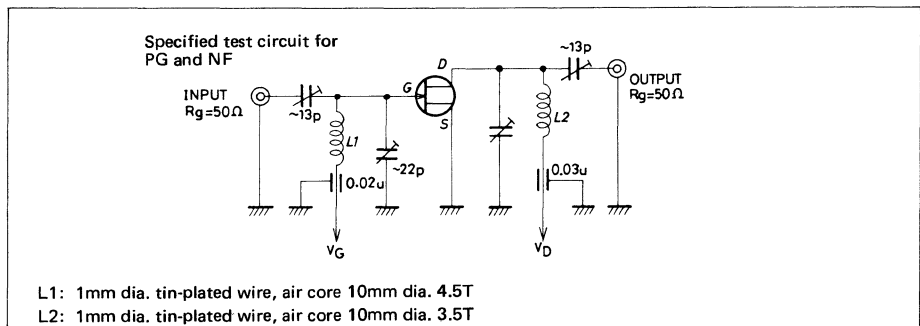
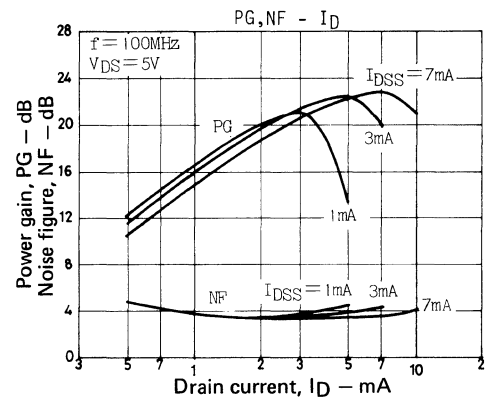
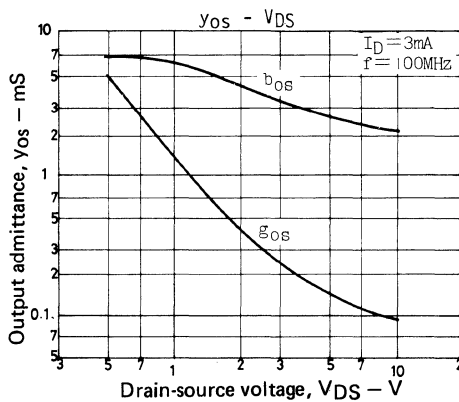
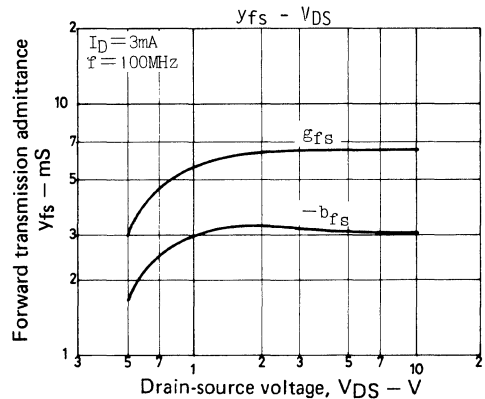
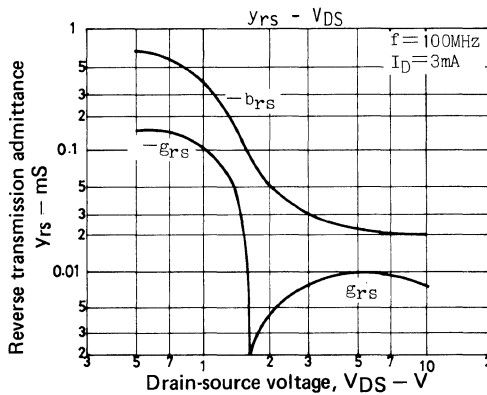
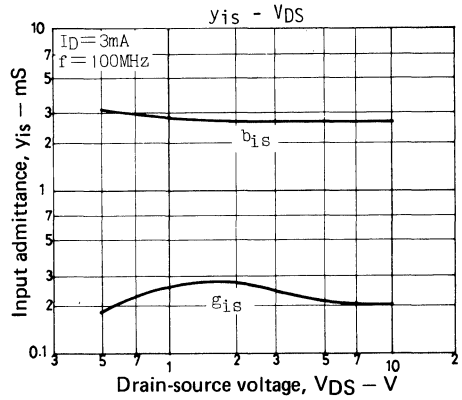
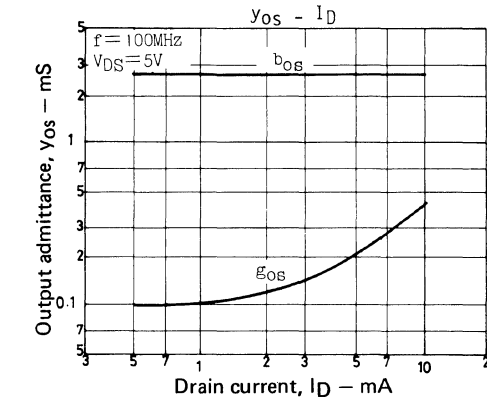
SANYO: SP

G: Gate
S: Source
D: Drain

2225MY, TS No.661-1/4







2SK222



2019A

N-Channel Junction
Silicon Field-Effect Transistor

Low Frequency, Low Noise Amp Applications

©836E

FEATURES

- * Ultra low noise figure
- * Large $|y_{fs}|$
- * Low gate leakage current.

ABSOLUTE MAXIMUM RATINGS/ $T_a = 25^\circ\text{C}$

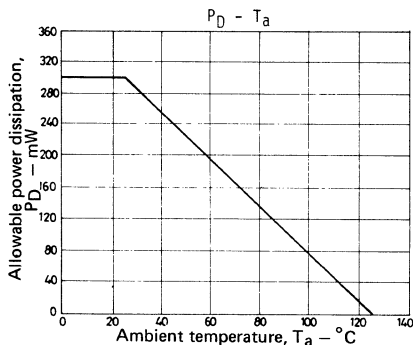
			unit
Drain-source voltage	V_{DS}	40	V
Gate-drain voltage	V_{GDS}	-40	V
Gate current	I_G	10	mA
Allowable power dissipation	P_D	300	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage ambient temperature	T_{stg}	-40 ~ +125	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS/ $T_a = 25^\circ\text{C}$

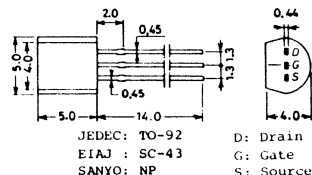
			min	typ	max	unit
Gate-drain breakdown voltage	$V_{(BR) GDS}$	$I_G = -100 \mu\text{A}$	-40			V
Gate cut-off current	V_{GSS}	$V_{GS} = -20 \text{ V}$			-1.0	nA
Cut-off voltage	$V_{GS}(\text{off})$	$V_{DS} = 10 \text{ V}, I_D = 10 \mu\text{A}$		0.5		V
Drain current	I_{DSS}	$V_{DS} = 10 \text{ V}, V_{GS} = 0$	0.6*		12.0*	mA
Mutual conductance	$ y_{fs} $	$V_{DS} = 10 \text{ V}, V_{GS} = 0, f = 1 \text{ kHz}$		17		mS
Input capacitance	C_{iss}	$V_{DS} = 10 \text{ V}, V_{GS} = 0, f = 1 \text{ MHz}$		14		pF
Feedback capacitance	C_{rss}	$V_{DS} = 10 \text{ V}, V_{GS} = 0, f = 1 \text{ MHz}$		3.5		pF
Noise figure	NF (1)	$V_{DS} = 10 \text{ V}, V_{GS} = 0, R_g = 1 \text{ k}\Omega, f = 100 \text{ Hz}$		1.0	3.0	dB
	NF (2)	$V_{DS} = 10 \text{ V}, V_{GS} = 0, R_g = 1 \text{ k}\Omega, f = 1 \text{ kHz}$		0.6	1.5	dB
Equivalent input noise voltage	V_{NI}	$V_{DS} = 10 \text{ V}, V_{GS} = 0, R_g = 1 \text{ k}\Omega, f = 1 \text{ kHz}$		2		$\text{nV}/\sqrt{\text{Hz}}$

* 2SK222 is graded as follows by drain current I_{DSS} (unit : mA).

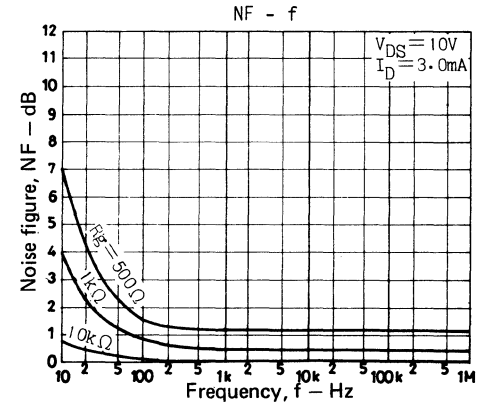
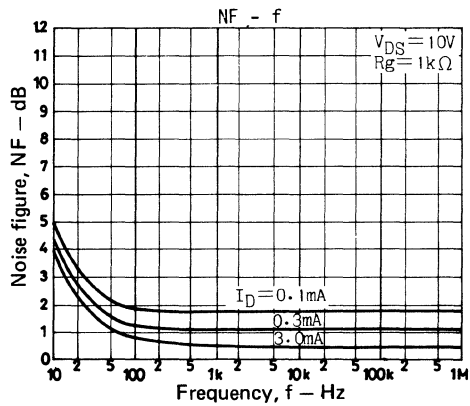
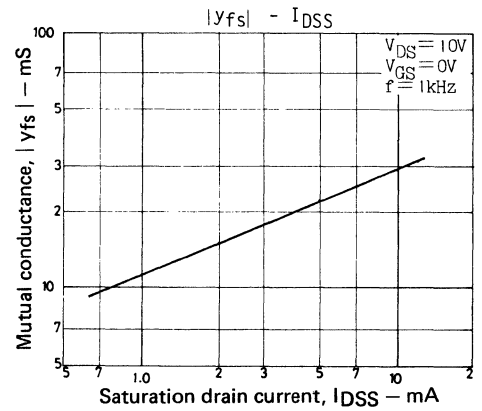
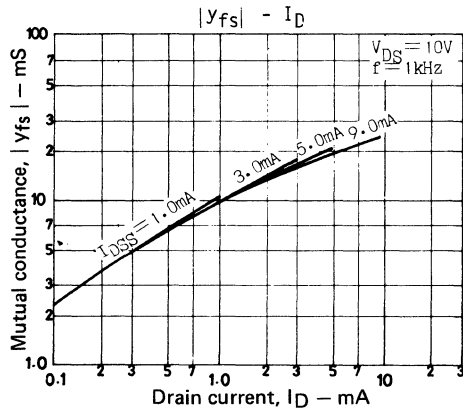
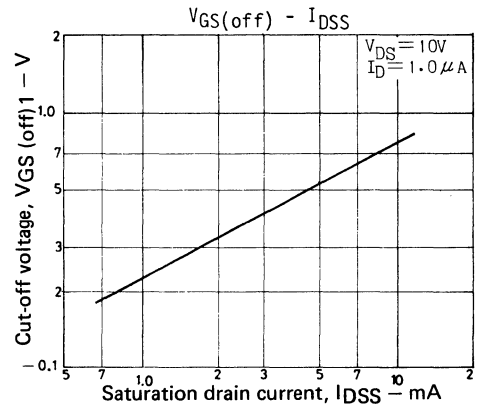
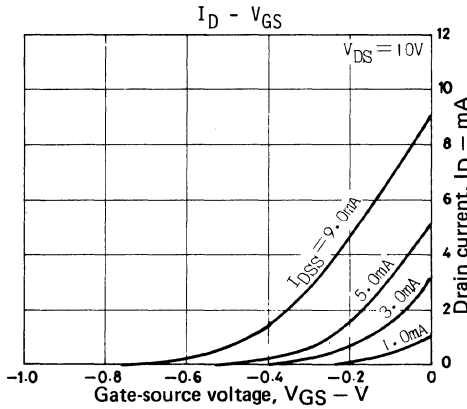
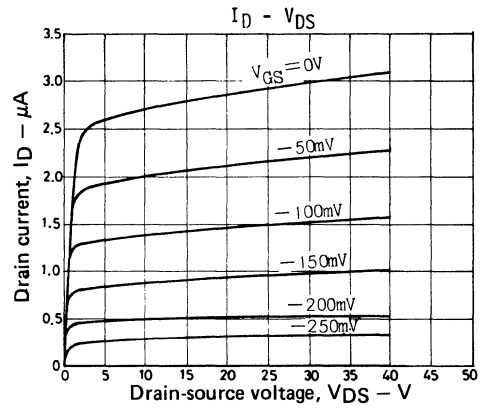
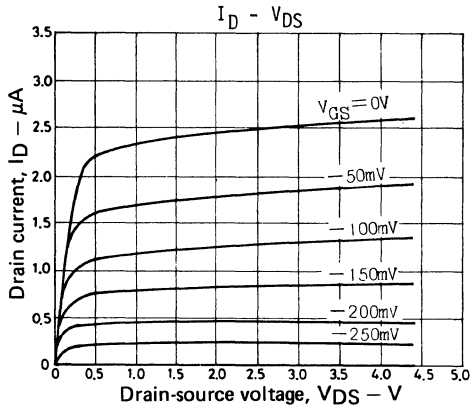
0.6	C	1.5	1.2	D	3.0	2.5	E	6.0	5.0	F	12.0
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Case outline 2019A
(unit : mm)



2075MY/No. 836-1/2



2SK223



2019A

N-Channel Junction
Silicon Field-Effect Transistor

High Voltage Driver Applications

©659H

FEATURES

- * Ultra high voltage withstanding ($V_{GDS} = -80$ V).
- * Due to low gate leakage currents even under high voltages, it is suitable for a wide range of applications ($I_{GDL} = 1$ nA/ $V_{DS} = 50$ V, $I_D = 1$ mA).
- * High $|y_{fs}|$ ($|y_{fs}| = 20$ mS/ $V_{DS} = 30$ V, $f = 1$ kHz).

ABSOLUTE MAXIMUM RATINGS/ $T_a = 25^\circ\text{C}$

			unit
Drain-source voltage	V_{DS}	80	V
Gate-drain voltage	V_{GDS}	-80	V
Gate current	I_G	10	mA
Allowable Power Dissipation	P_D	400	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage ambient temperature	T_{stg}	-40 ~ +125	$^\circ\text{C}$

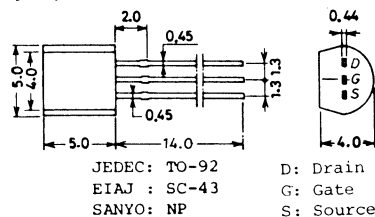
ELECTRICAL CHARACTERISTICS/ $T_a = 25^\circ\text{C}$

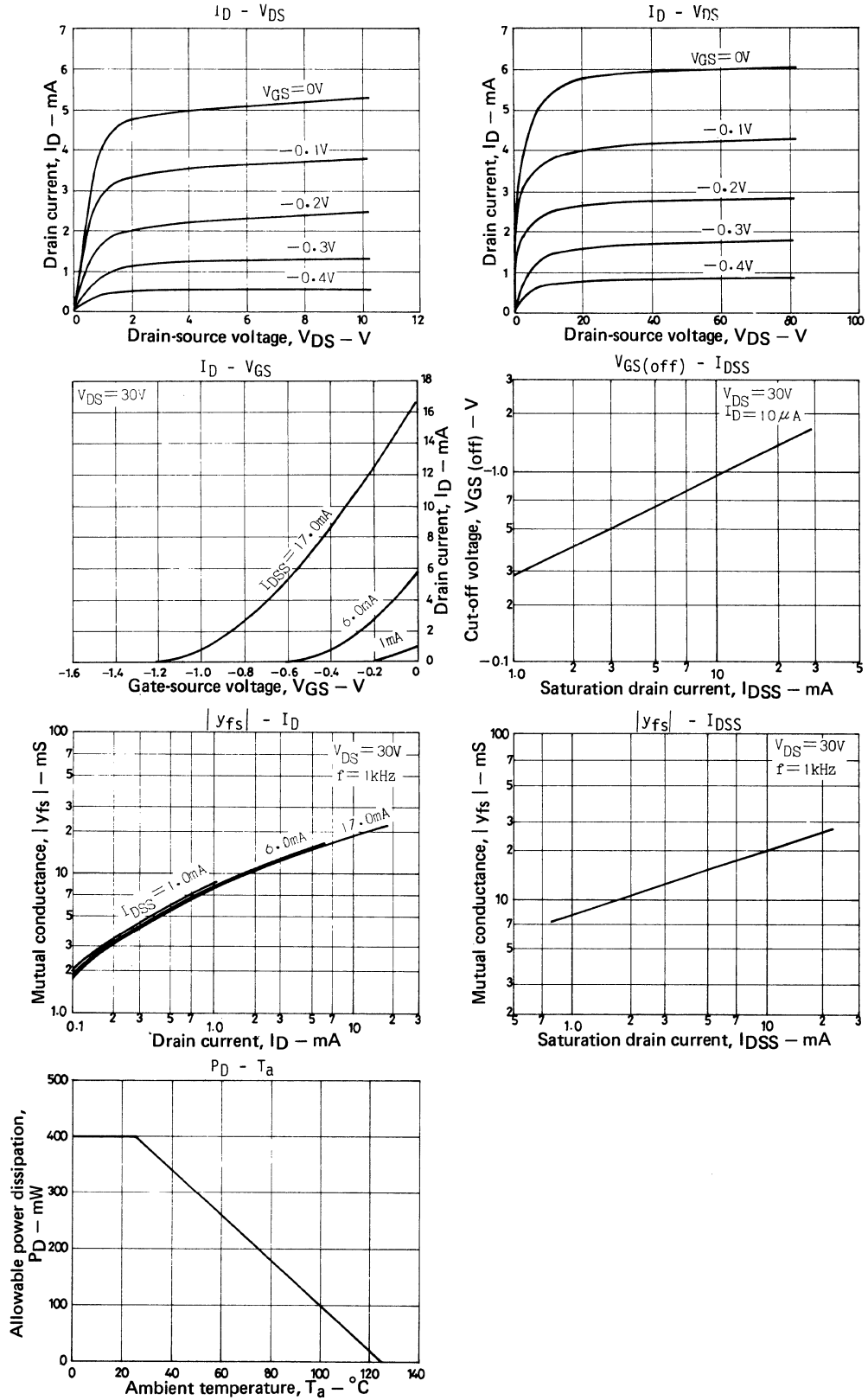
			min	typ	max	unit
Gate-drain breakdown voltage	$V_{(BR) GDS}$	$I_G = -100 \mu\text{A}$	-80			V
Gate cut-off current	I_{GSS}	$V_{GS} = -30\text{V}, V_{DS} = 0\text{V}$			-1.0	nA
Drain current	I_{DSS}^*	$V_{DS} = 30\text{V}, V_{GS} = 0\text{V}$	1.2*		24*	mA
Cut-off voltage	$V_{GS}(\text{off})$	$V_{DS} = 30\text{V}, I_D = 10 \mu\text{A}$		-0.75		V
Mutual conductance	$ y_{fs} $	$V_{DS} = 30\text{V}, V_{GS} = 0\text{V}, f = 1 \text{ kHz}$		20		mS
Input capacitance	C_{iss}	$V_{DS} = 30\text{V}, V_{GS} = 0, f = 1 \text{ MHz}$		12		pF
Feedback capacitance	C_{rss}	$V_{DS} = 30\text{V}, V_{GS} = 0\text{V}, f = 1 \text{ MHz}$		2.5		pF
Noise figure	NF	$V_{DS} = 10\text{V}, I_D = 3 \text{ mA}, R_g = 10 \text{ k}\Omega, f = 1 \text{ kHz}$		1.0		dB

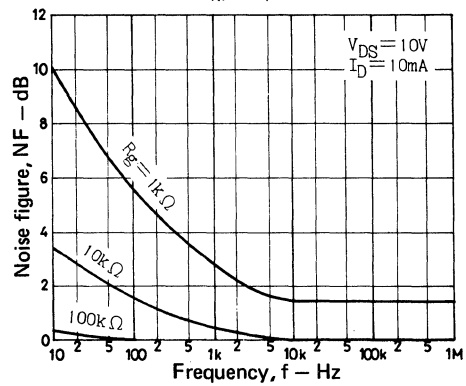
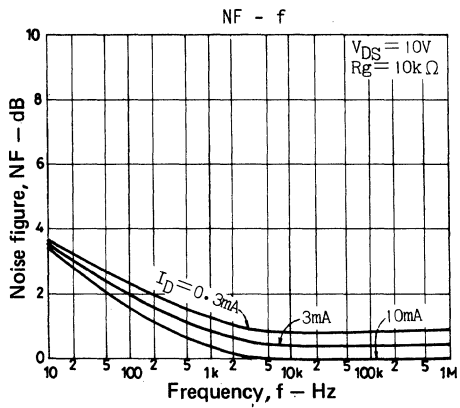
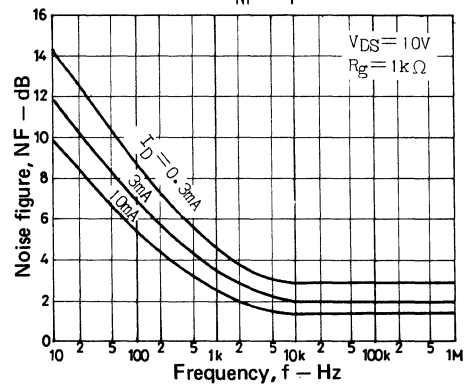
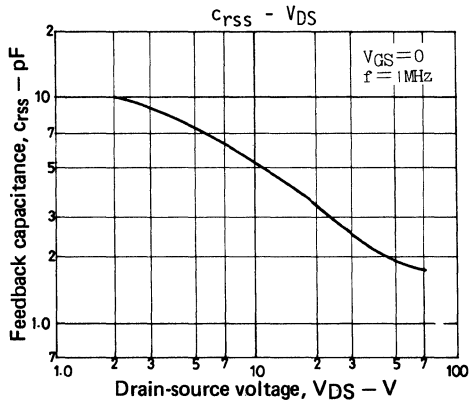
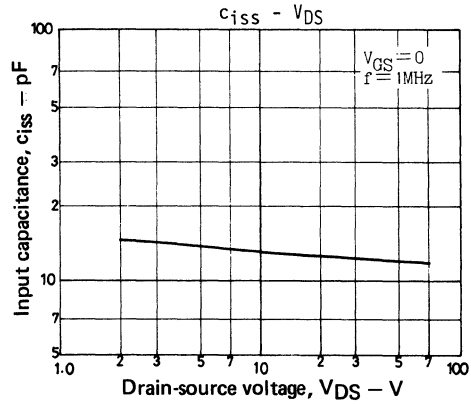
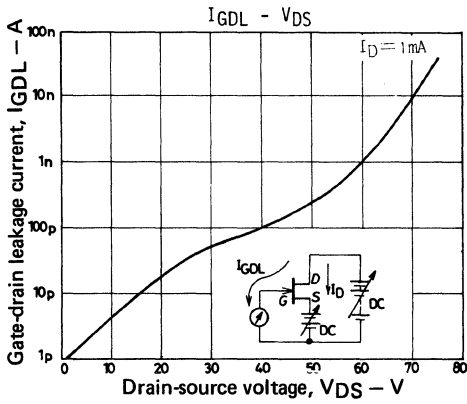
* 2SK223 is graded as follows by I_{DSS} at $V_{DS} = 30$ V (unit: mA).

1.2	D	3.0	2.5	E	6.0	5.0	F	12.0	10	G	24
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Case Outline 2019A (unit:mm)







2SK242

2024

N-Channel Junction
Silicon Field-Effect Transistor

High Frequency, General-Purpose Amp Applications

©695E

FEATURES

- * Because it is encapsulated in an ultra compact package, compact and low profile sets can be designed.
- * Small c_{rss} ($c_{rss} = 0.04$ pF typ).

ABSOLUTE MAXIMUM RATINGS/ $T_a = 25^\circ\text{C}$

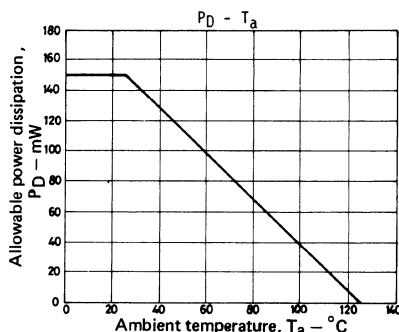
			unit
Gate-drain voltage	V_{GDO}	-20	V
Gate current	I_G	10	mA
Drain current	I_D	20	mA
Allowable power dissipation	P_D	150	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage ambient temperature	T_{stg}	-55 ~ +125	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS/ $T_a = 25^\circ\text{C}$

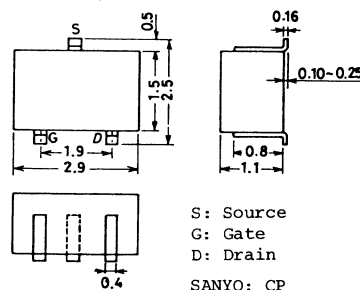
			min	typ	max	unit
Gate-drain breakdown voltage	$V_{(BR)} GDO$	$I_G = -10 \mu\text{A}$	-20			V
Gate cut-off current	I_{GSS}	$V_{GS} = -0.5 \text{ V}, V_{DS} = 0 \text{ V}$			-10	nA
Drain current	I_{DSS}	$V_{DS} = 5 \text{ V}, V_{GS} = 0 \text{ V}$	0.6		12.0	mA
Cut-off voltage	$V_{GS}(\text{off})$	$V_{DS} = 5 \text{ V}, I_D = 10 \mu\text{A}$			-2.5	V
Forward transmission admittance	$ y_{fs} (1)$	$V_{DS} = 5 \text{ V}, V_{GS} = 0 \text{ V},$ $f = 1 \text{ kHz}$	2.0	6.0		mS
	$ y_{fs} (2)$	$V_{DS} = 5 \text{ V}, V_{GS} = 0 \text{ V},$ $f = 100 \text{ MHz}$	2.0	6.0		mS
Input capacitance	c_{iss}	$V_{DS} = 5 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$		4.0		pF
Feedback capacitance	c_{rss}	$V_{DS} = 5 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$		0.04	0.15	pF
Output capacitance	c_{oss}	$V_{DS} = 5 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$		4.0		pF
Power gain	PG	$V_{DS} = 5 \text{ V}, V_{GS} = 0 \text{ V}, f = 100 \text{ MHz}$ Refer to specified test circuit		24		dB
Noise figure	NF	$V_{DS} = 5 \text{ V}, V_{GS} = 0 \text{ V}, f = 100 \text{ MHz}$ Refer to specified test circuit		3.5	6.0	dB

* 2SK242 is graded as follows by I_{DSS} (unit : mA):

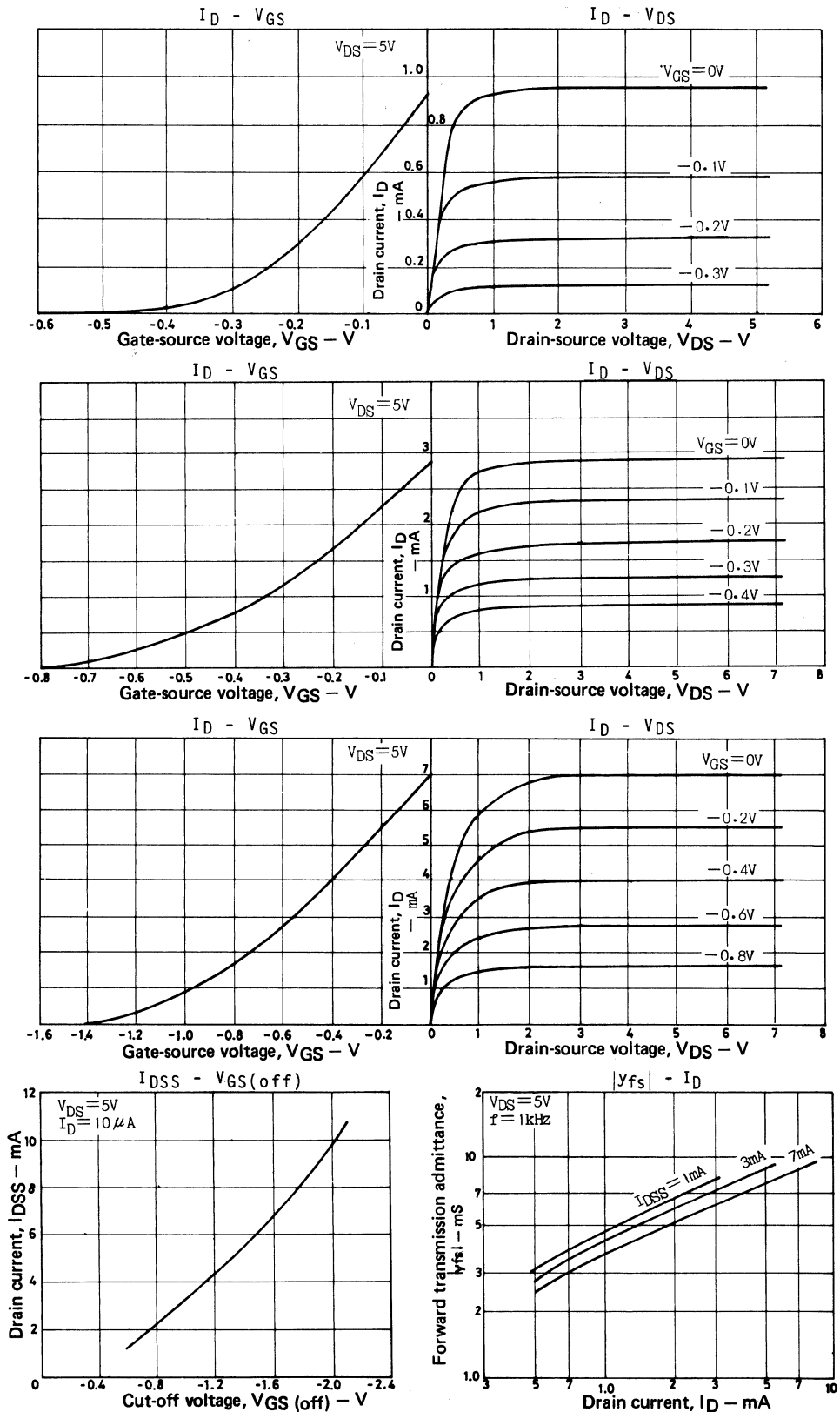
0.6	T2	1.5	1.2	T3	3.0	2.5	T4	6.0	5.0	T5	12.0
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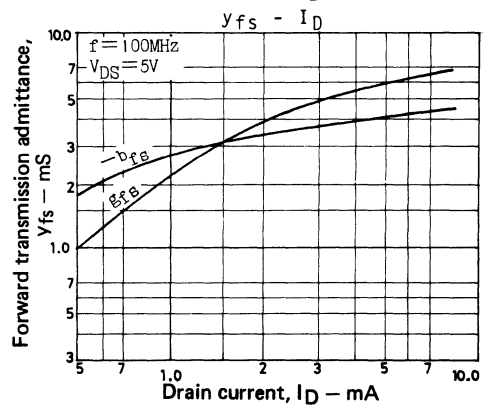
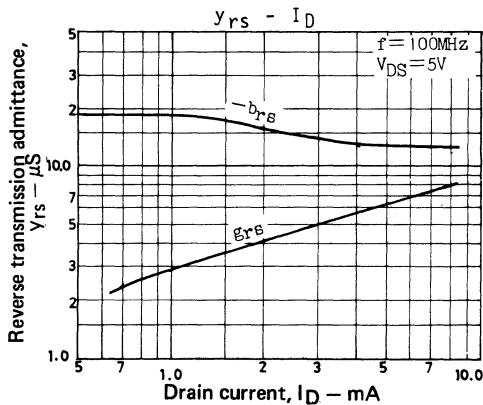
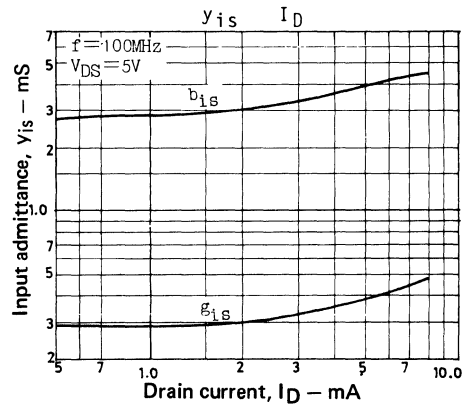
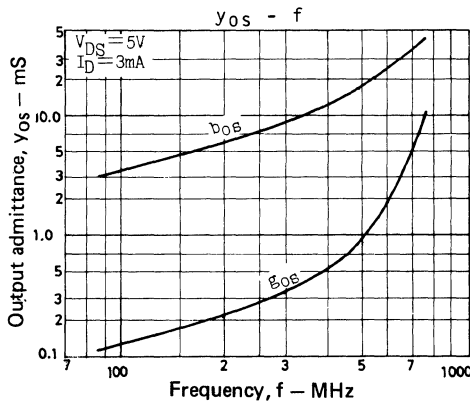
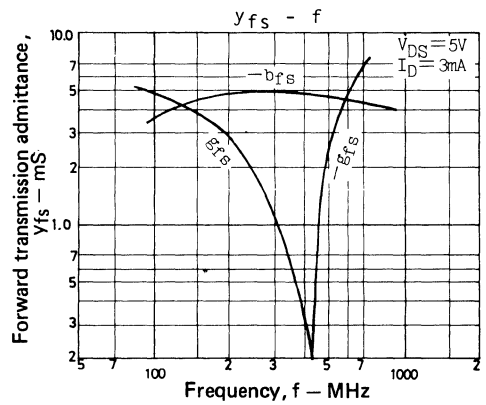
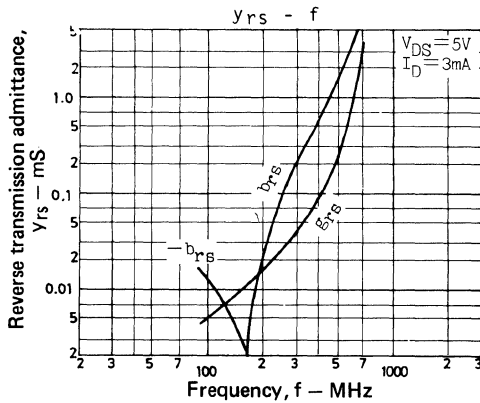
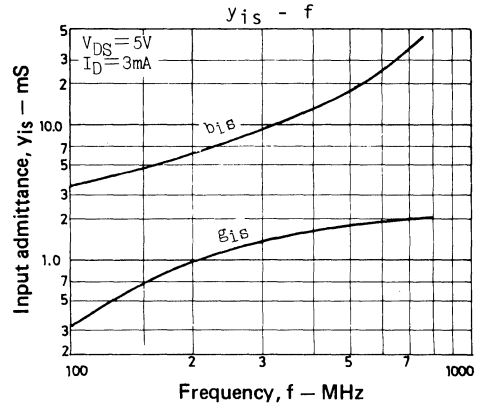
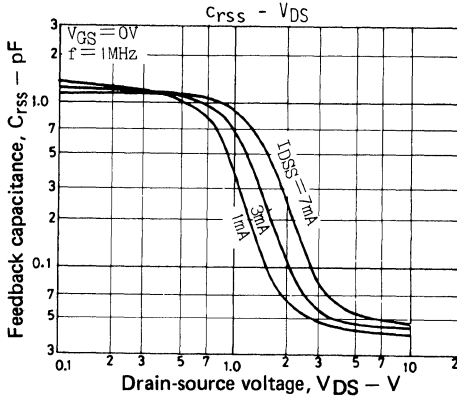


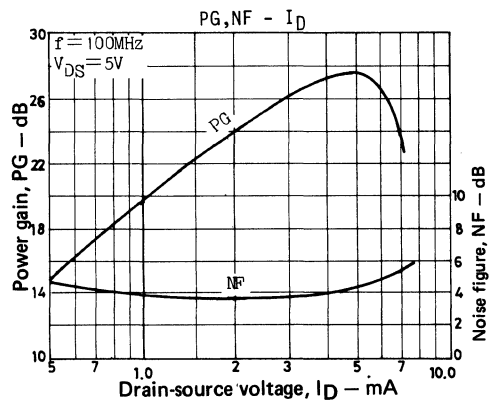
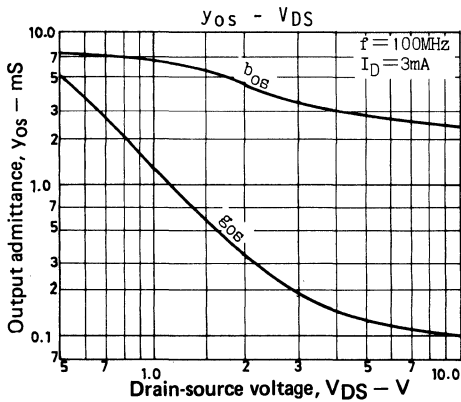
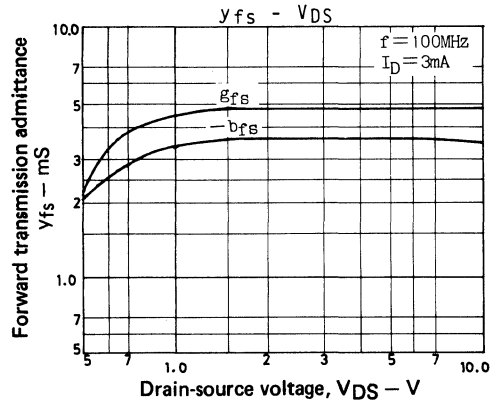
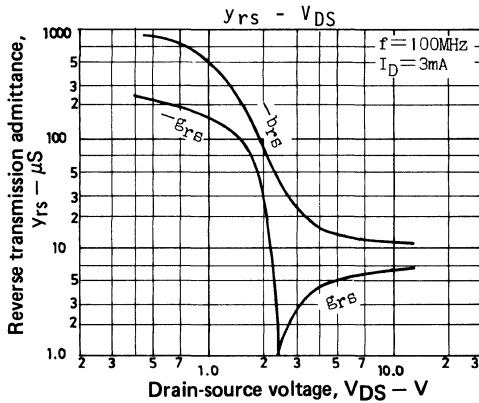
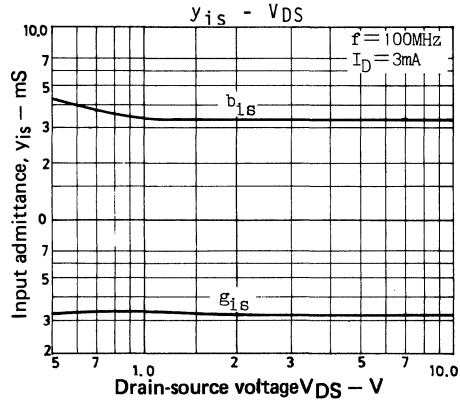
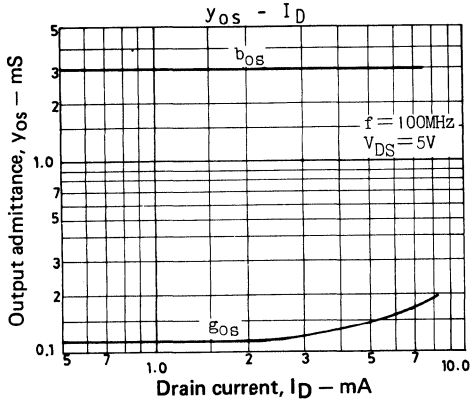
Case Outline 2024 (unit:mm)



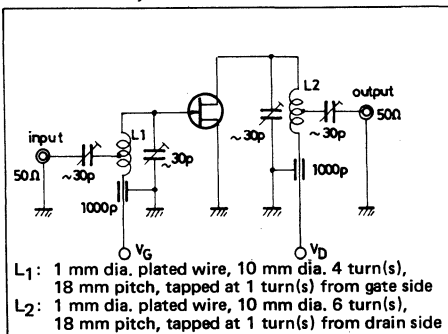
3075MY, TS No.695-1/4







PG, NF Test Circuit



2SK283



2021

N-Channel Junction
Silicon Field-Effect Transistor

High Voltage Driver Applications

©794D

FEATURES

- * Because it is encapsulated in an ultra compact package, compact and low-profile sets can be designed.
- * Ultra high voltage withstanding.
- * Due to low gate leakage currents even at high voltages, it is suited for a wide range of applications.
- * High $|y_{fs}|$.

ABSOLUTE MAXIMUM RATINGS/ $T_a = 25^\circ\text{C}$

			unit
Drain-source voltage	V_{DS}	80	V
Gate-drain voltage	V_{GD}	-80	V
Gate current	I_G	10	mA
Allowable power dissipation	P_D (1)	150	mW
	P_D (2)	4 x 4 x 0.2 mm ³ copper foil area on glass epoxy board	280 mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage ambient temperature	T_{stg}	-40 ~ +125	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS/ $T_a = 25^\circ\text{C}$

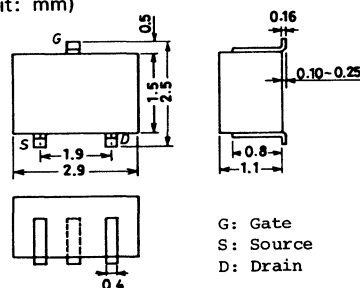
			min	typ	max	unit
Gate-drain breakdown voltage	$V_{(BR)} GDS$	$I_G = -100 \mu\text{A}$	-80			V
Gate cut-off current	I_{GSS}	$V_{GS} = -30 \text{ V}$			-1.0	nA
Drain current	I_{DSS}	$V_{DS} = 30 \text{ V}, V_{GS} = 0 \text{ V}$	1.2*		17.0*	mA
Cut-off voltage	$V_{GS}(\text{off})$	$V_{DS} = 30 \text{ V}, I_D = 10 \mu\text{A}$		-0.75		V
Mutual conductance	$ y_{fs} $	$V_{DS} = 30 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ kHz}$		20		mS
Input capacitance	c_{iss}	$V_{DS} = 30 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$		12		pF
Feedback capacitance	c_{rss}	$V_{DS} = 30 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$		2.5		pF

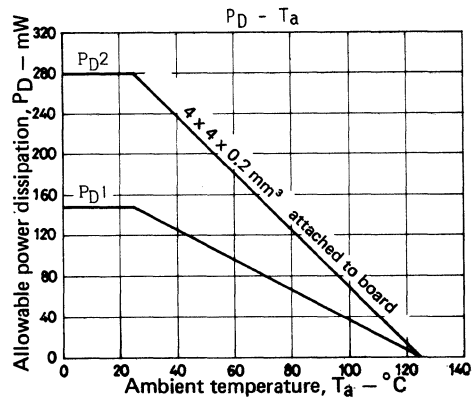
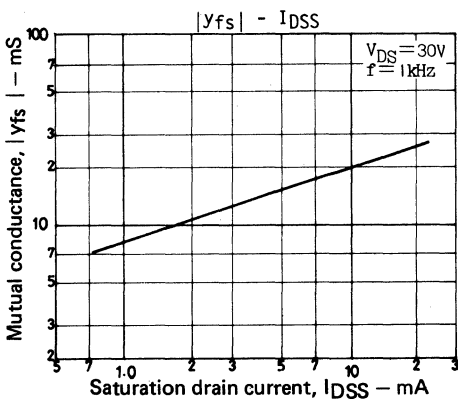
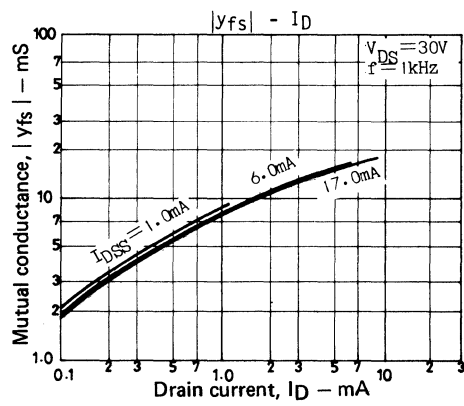
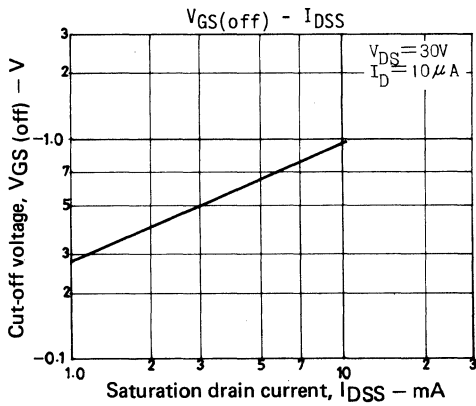
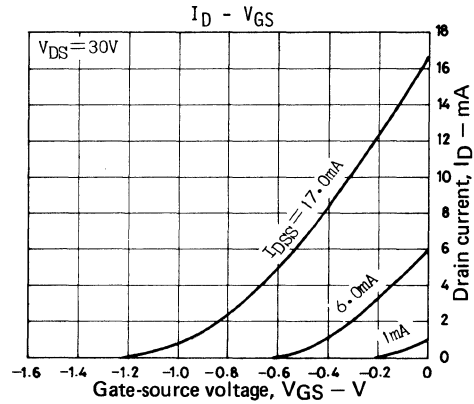
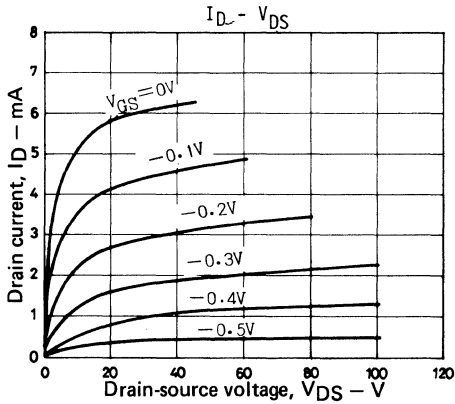
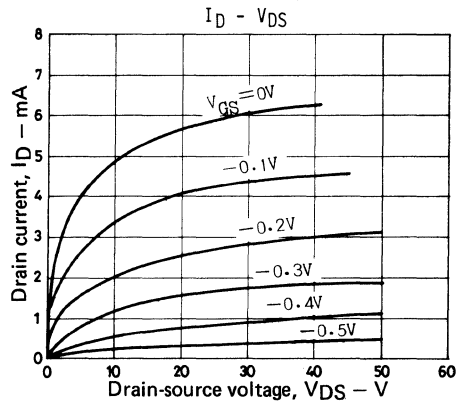
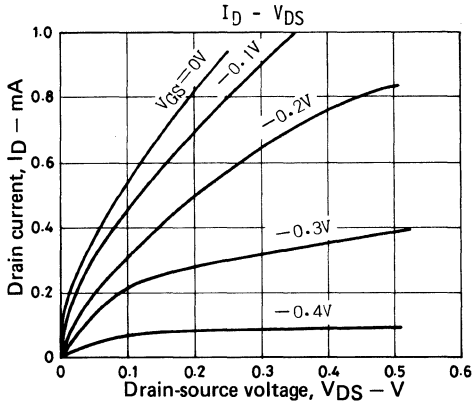
* 2SK283 is graded as follows by I_{DSS} at $V_{DS} = 30 \text{ V}$ (unit : mA):

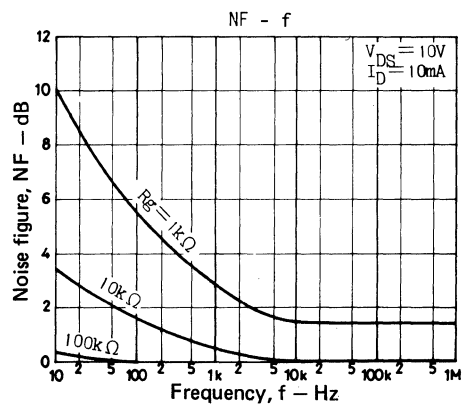
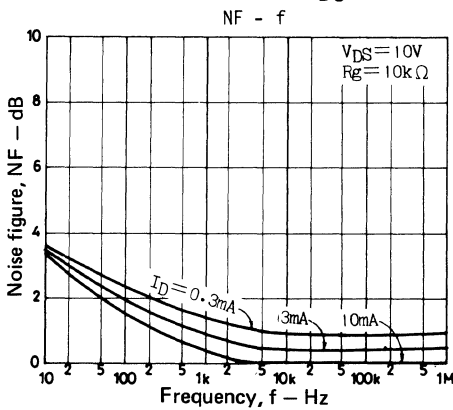
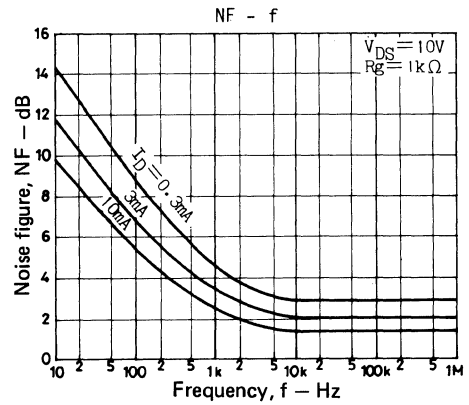
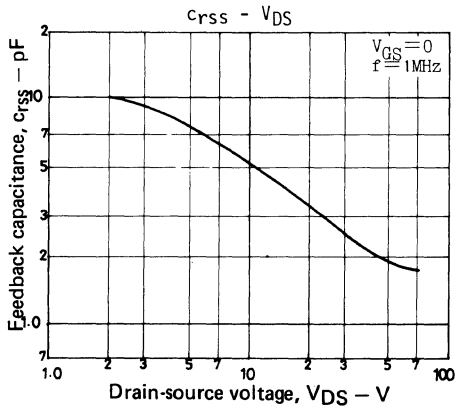
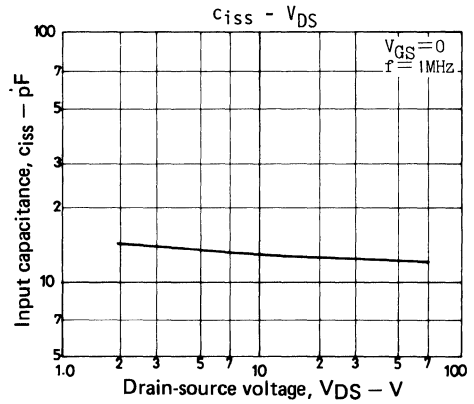
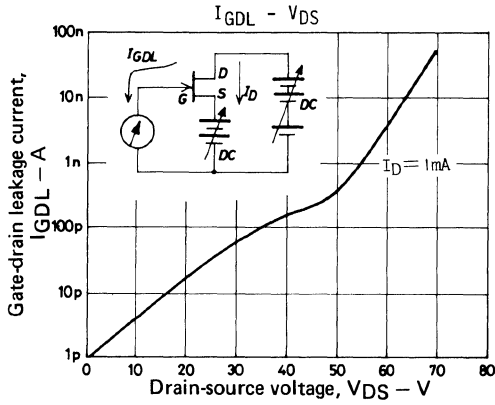
1.2 R3 3.0	2.5 R4 6.0	5.0 R5 12.0	10.0 R6 17.0
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Case Outline 2021

(unit: mm)







2SK303



2021

N-Channel Junction
Silicon Field-Effect Transistor

Low Frequency, General-Purpose Amp Applications

Ⓔ856D

APPLICATIONS

- * Ideal for potentiometers, analog switches, low frequency amplifiers, and constant current supplies.

ABSOLUTE MAXIMUM RATINGS/ $T_a = 25^\circ\text{C}$

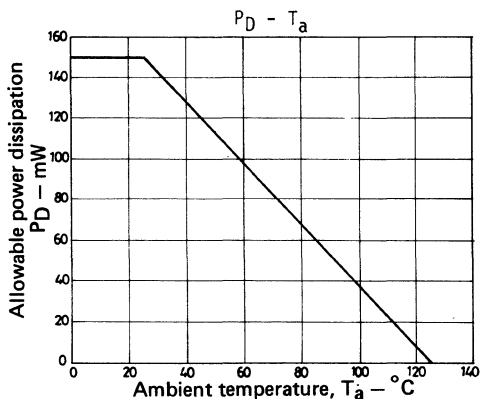
			unit
Drain-source voltage	V_{DS}	30	V
Gate-drain voltage	V_{GDS}	-30	V
Gate current	I_G	10	mA
Drain current	I_D	20	mA
Allowable power dissipation	P_D	150	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage ambient temperature	T_{stg}	-40 ~ +125	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS/ $T_a = 25^\circ\text{C}$

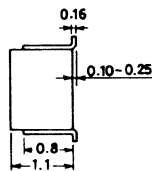
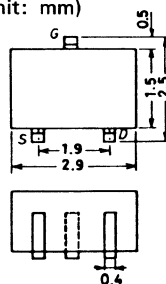
			min	typ	max	unit
Gate-drain breakdown voltage	$V_{(BR) GDS}$	$I_G = -10 \mu\text{A}$	-30			V
Gate cut-off current	I_{GSS}	$V_{GS} = -20 \text{ V}$			-1.0	nA
Drain current	I_{DSS}	$V_{DS} = 10 \text{ V}, V_{GS} = 0$	0.6*		12.0*	mA
Cut-off voltage	$V_{GS}(\text{off})$	$V_{DS} = 10 \text{ V}, I_D = 1 \mu\text{A}$		-1	-4	V
Mutual conductance	$ y_{fs} $	$V_{DS} = 10 \text{ V}, V_{GS} = 0, f = 1 \text{ kHz}$	2.5	6.0		mS
Input capacitance	C_{iss}	$V_{DS} = 10 \text{ V}, V_{GS} = 0, f = 1 \text{ MHz}$		5		pF
Feedback capacitance	C_{rss}	$V_{DS} = 10 \text{ V}, V_{GS} = 0, f = 1 \text{ MHz}$		1.5		pF

- * 2SK303 is graded as follows by I_{DSS} at $V_{DS} = 10 \text{ V}$ (unit: mA).

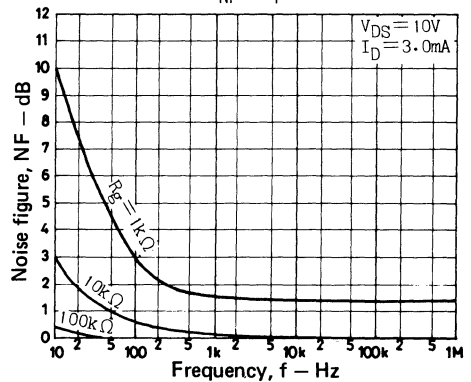
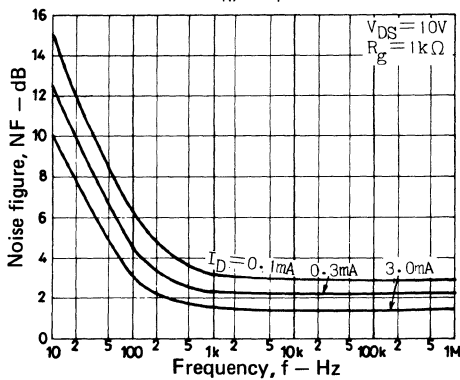
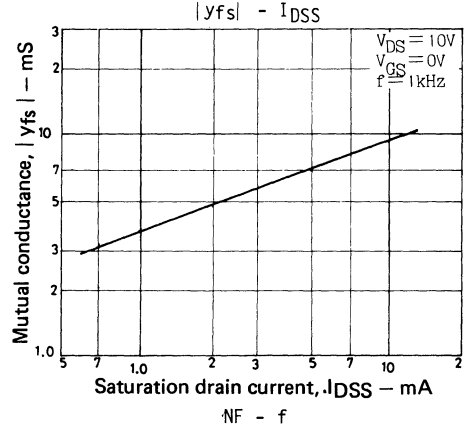
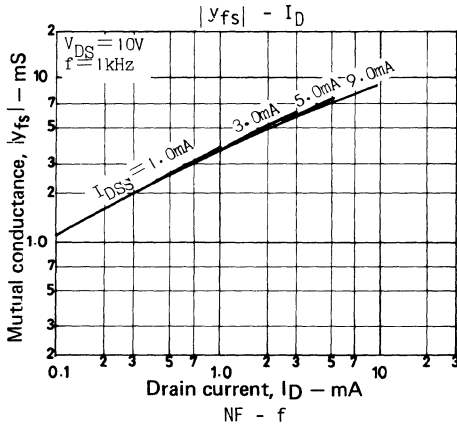
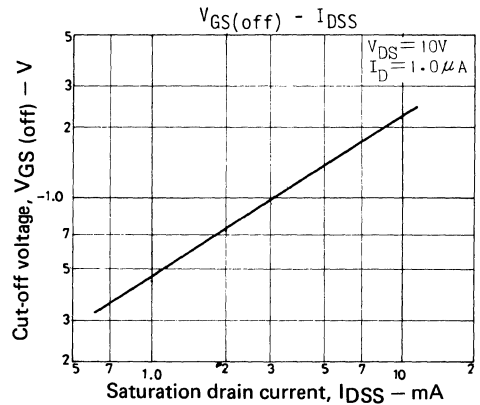
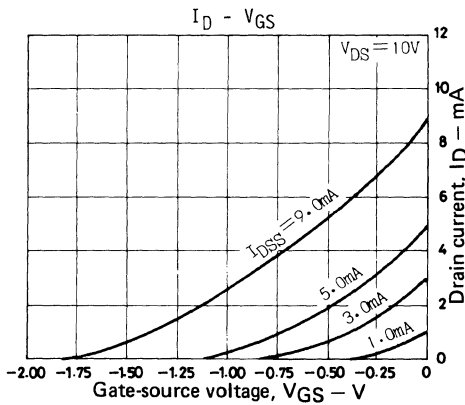
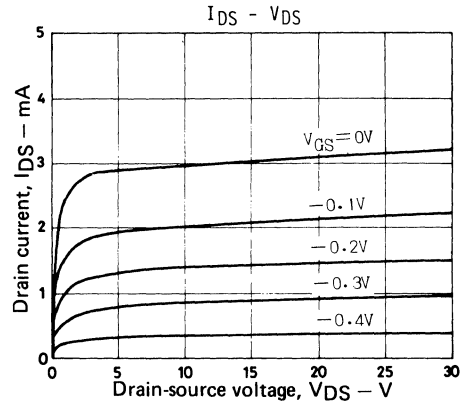
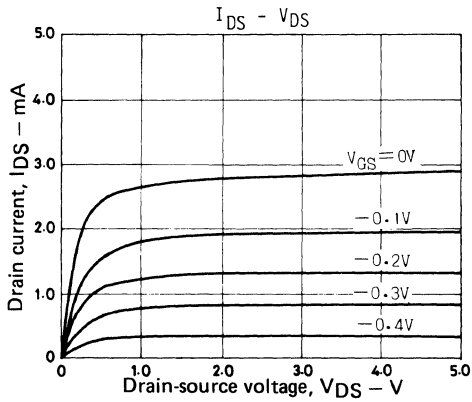
0.6 V2 1.5	1.2 V3 3.0	2.5 V4 6.0	5.0 V5 12.0
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Case Outline 2021
(unit: mm)



G: Gate
S: Source
D: Drain



2SK304



2001B

N-Channel Junction
Silicon Field-Effect Transistor

Low Frequency, General-Purpose Amp Applications

Ⓔ850C

APPLICATIONS

* Ideal for potentiometers, analog switches, low frequency amplifiers, and constant current supplies.

ABSOLUTE MAXIMUM RATINGS/ $T_a = 25^\circ\text{C}$

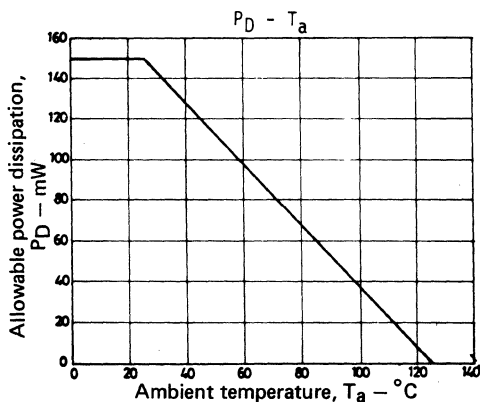
			unit
Drain-source voltage	V_{DS}	30	V
Gate-drain voltage	V_{GDS}	-30	V
Gate-current	I_G	10	mA
Drain current	I_D	20	mA
Allowable power dissipation	P_D	150	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage ambient temperature	T_{stg}	-40 ~ +125	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS/ $T_a = 25^\circ\text{C}$

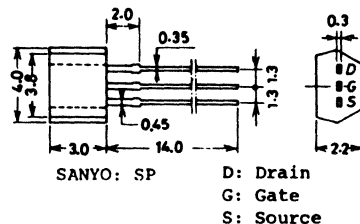
			min	typ	max	unit
Gate-drain breakdown voltage	$V_{(BR) GDS}$	$I_G = -10 \mu\text{A}$	-30			V
Gate cut-off current	I_{GSS}	$V_{GS} = -20 \text{ V}$			-1.0	nA
Drain current	I_{DSS}	$V_{DS} = 10 \text{ V}, V_{GS} = 0$	0.6*		12.0*	mA
Cut-off voltage	$V_{GS (off)}$	$V_{DS} = 10 \text{ V}, I_D = 1 \mu\text{A}$		-1	-4	V
Mutual conductance	$ y_{fs} $	$V_{DS} = 10 \text{ V}, V_{GS} = 0, f = 1 \text{ kHz}$	2.5	6.0		mS
Input capacitance	c_{iss}	$V_{DS} = 10 \text{ V}, V_{GS} = 0, f = 1 \text{ MHz}$		5		pF
Feedback capacitance	c_{rss}	$V_{DS} = 10 \text{ V}, V_{GS} = 0, f = 1 \text{ MHz}$		1.5		pF

* 2SK304 is graded as follows by I_{DSS} at $V_{DS} = 10 \text{ V}$ (unit : mA):

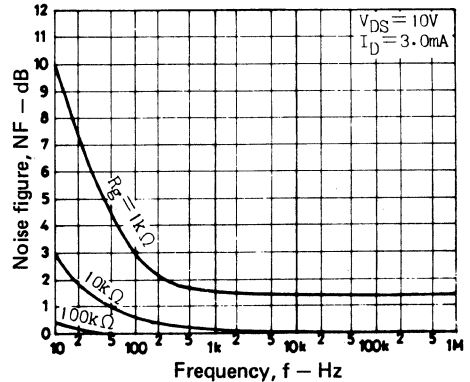
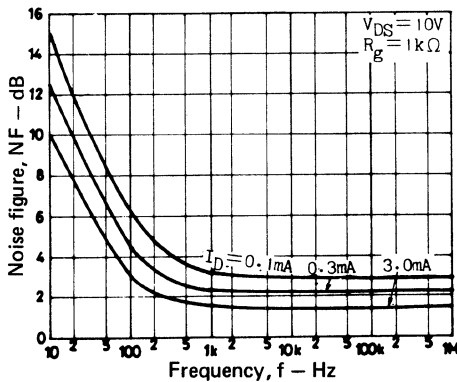
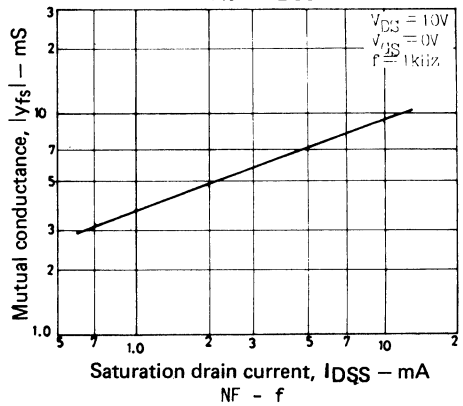
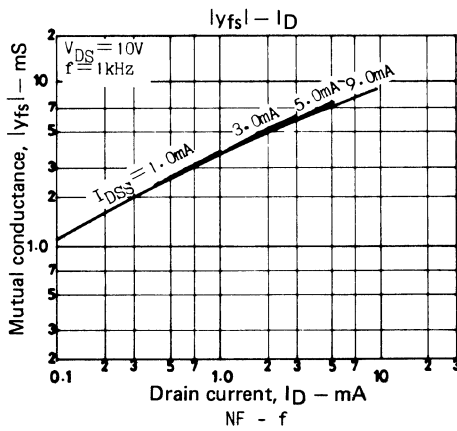
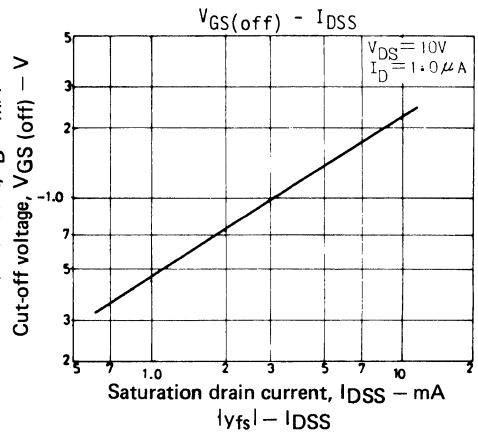
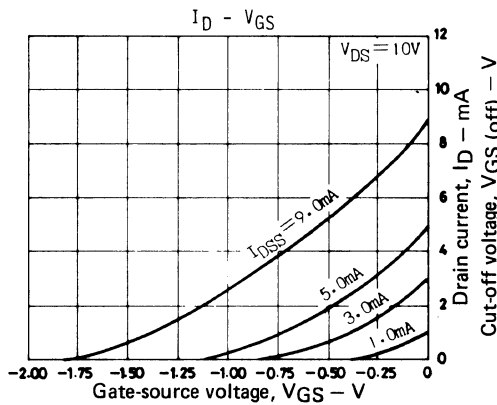
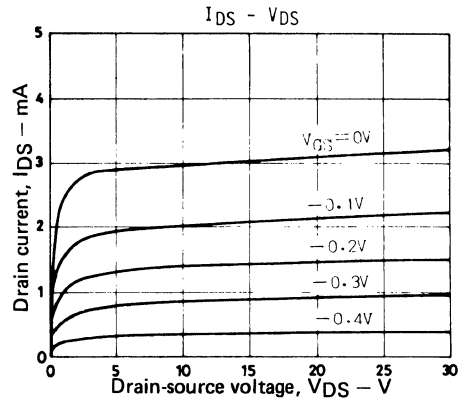
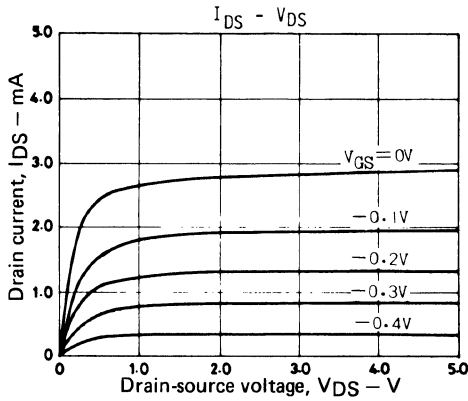
0.6	C	1.5	1.2	D	3.0	2.5	E	6.0	5.0	F	12.0
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Case Outline 2001B
(unit:mm)



2225MY, TS No.850-1/2



2SK315



2002B

N-Channel Junction
Silicon Field-Effect Transistor

FM Tuner Applications

©1005A

Features

- . Ideal for FM tuners in radios, stereos, etc.
- . Because it is compactly packaged, sets can be made compact.
- . Small c_{rss} ($c_{rss}=0.08\text{pF}$ typ).
- . High y_{fs} ($y_{fs}=12.0\text{ms}$ typ).

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

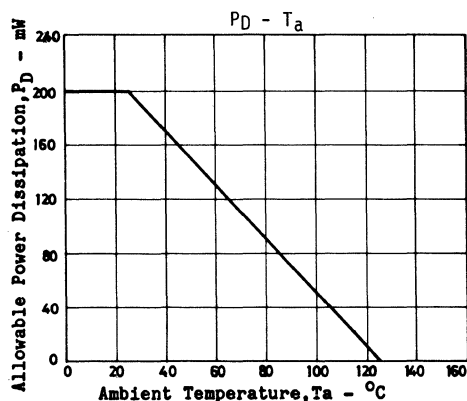
			unit
Gate to drain voltage	V_{GDO}	-20	V
Gate current	I_G	10	mA
Drain current	I_D	20	mA
Allowable power dissipation	P_D	200	mW
Junction temperature	T_J	125	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 to +125	$^\circ\text{C}$

Electrical Characteristics at $T_a=25^\circ\text{C}$

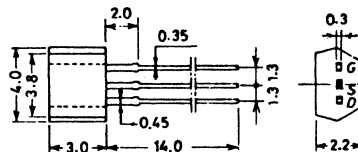
			min	typ	max	unit
Gate to drain breakdown voltage	$V_{(BR)GDO}$	$I_G=-10\mu\text{A}$	-20			V
Gate cutoff current	I_{GSS}	$V_{GS}=-0.5\text{V}, V_{DS}=0\text{V}$			-10	nA
Drain current	I_{DSS}	$V_{DS}=5\text{V}, V_{GS}=0\text{V}$	2.5		24.0	mA
Cutoff voltage	$V_{GS(off)}$	$V_{DS}=5\text{V}, I_D=10\mu\text{A}$			-3.5	V
Forward transfer admittance	$y_{fs} (1)$	$V_{DS}=5\text{V}, V_{GS}=0\text{V}, f=1\text{kHz}$	6.0	12.0		ms
Forward transfer admittance	$y_{fs} (2)$	$V_{DS}=5\text{V}, V_{GS}=0\text{V}, f=100\text{MHz}$	6.0	12.0		ms
Input capacitance	c_{iss}	$V_{DS}=5\text{V}, V_{GS}=0\text{V}, f=1\text{MHz}$		8.0		pF
Reverse transfer capacitance	c_{rss}	$V_{DS}=5\text{V}, V_{GS}=0\text{V}, f=1\text{MHz}$		0.08	0.3	pF
Output capacitance	c_{oss}	$V_{DS}=5\text{V}, V_{GS}=0\text{V}, f=1\text{MHz}$		6.5		pF
Power gain	PG	$V_{DS}=5\text{V}, V_{GS}=0\text{V}, f=100\text{MHz}$		23		dB
		Refer to specified test circuit.				
Noise figure	NF	$V_{DS}=5\text{V}, V_{GS}=0\text{V}, f=100\text{MHz}$		2.2	4.0	dB
		Refer to specified test circuit.				

* The 2SK315 is graded as follows by I_{DSS} :

2.5	E	6.0	5.0	F	12.0	10.0	G	24.0
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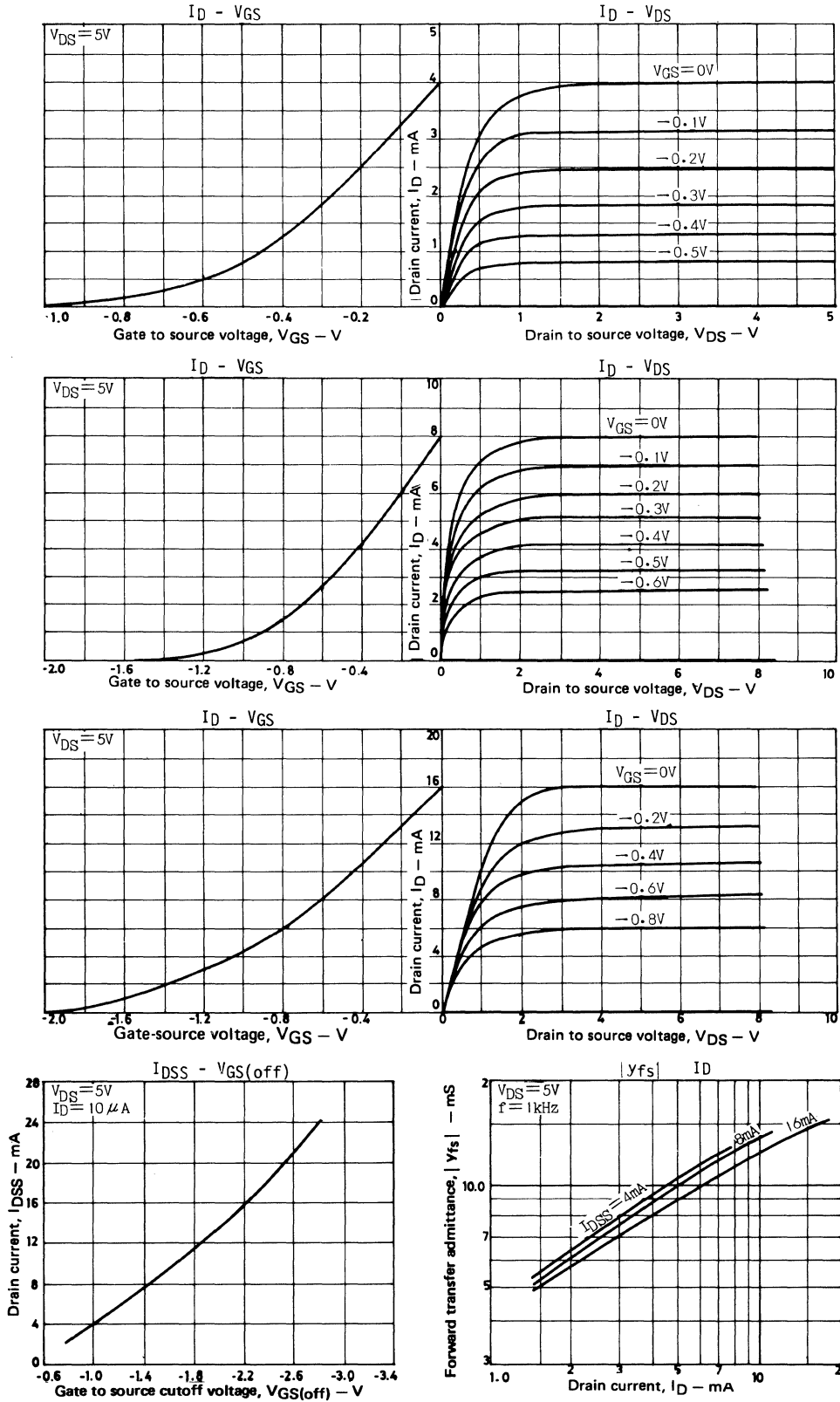
Case Outline 2002B
(unit:mm)

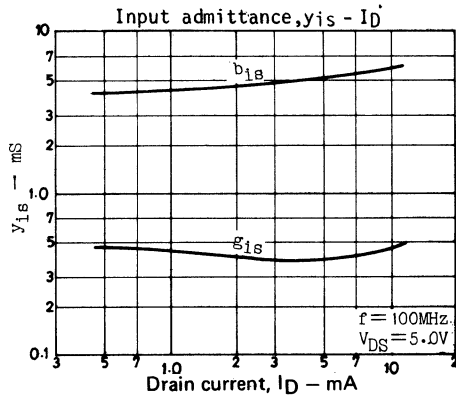
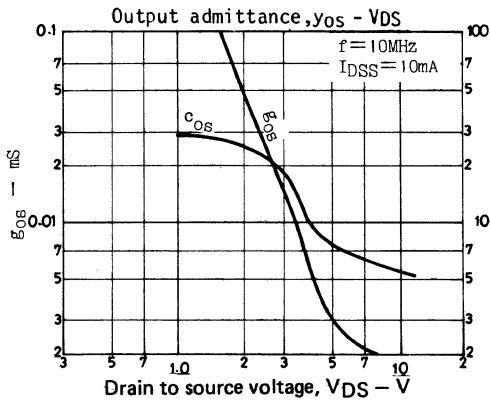
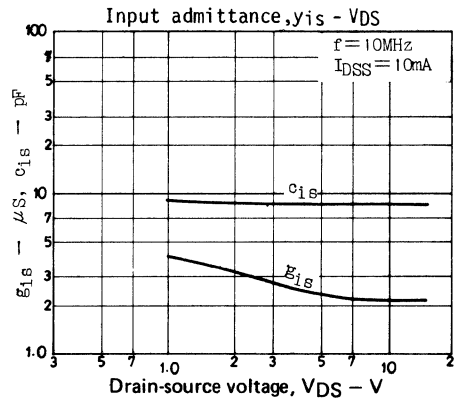
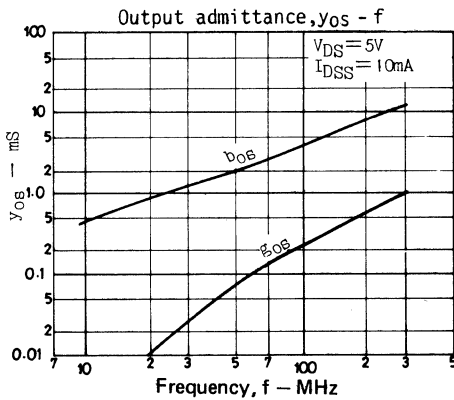
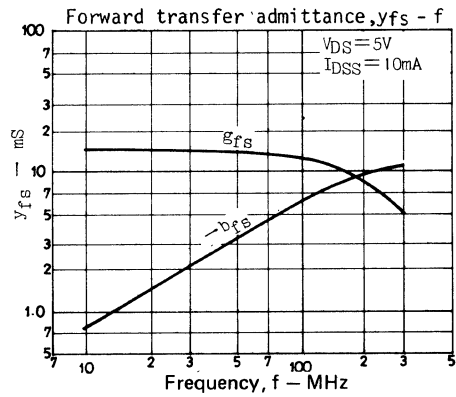
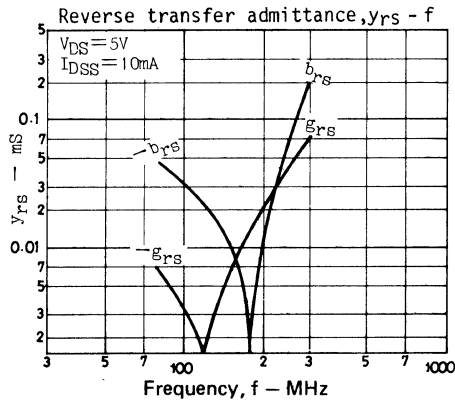
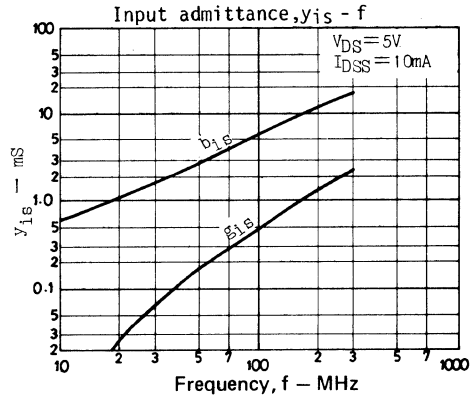
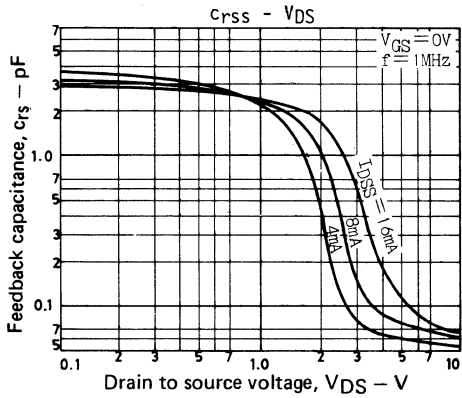


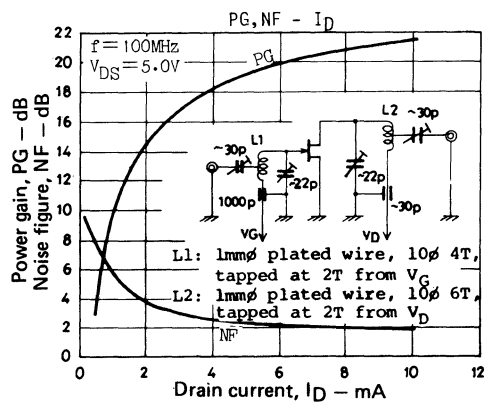
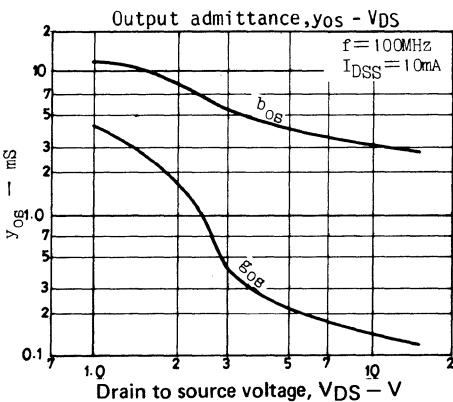
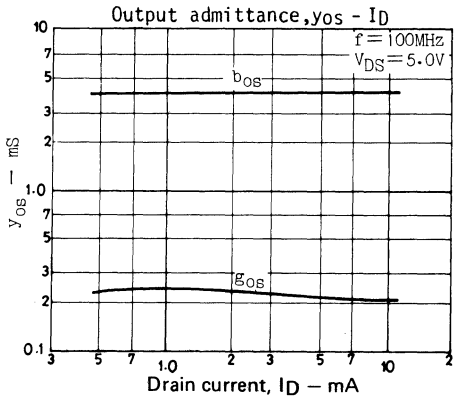
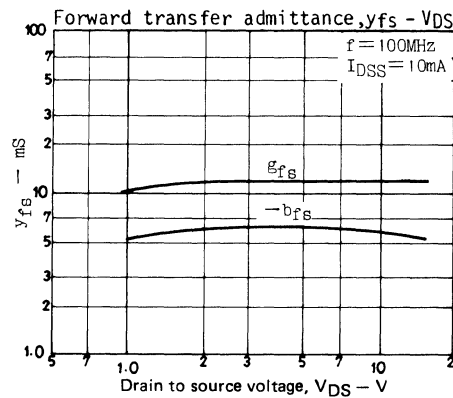
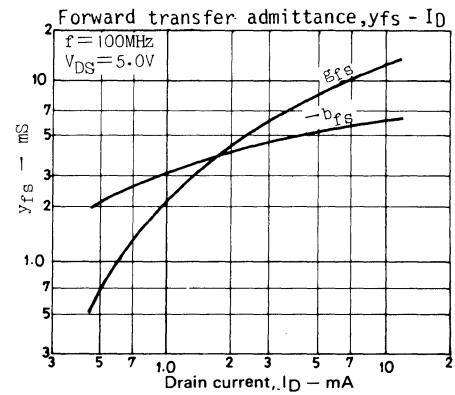
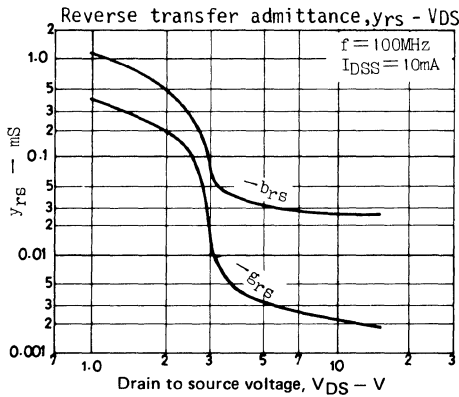
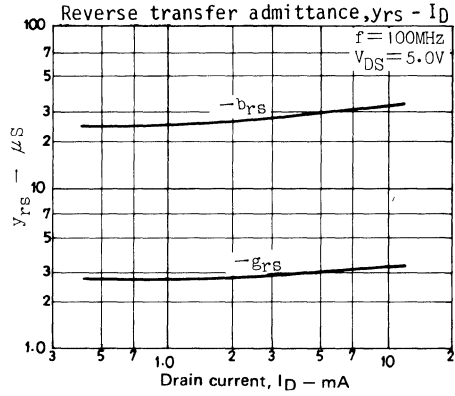
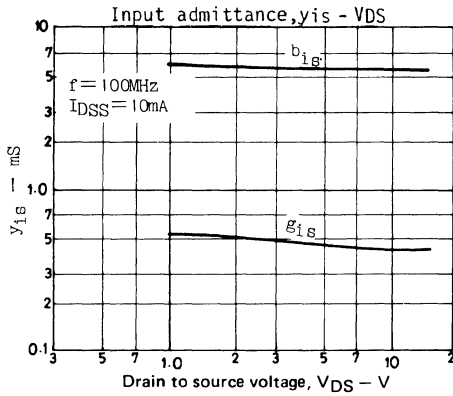
SANYO: SP

G:Gate
S:Source
D:Drain

3145KI/No.1005-1/4







2SK332



2027A



2028A

N-Channel Junction
Silicon Field-Effect Transistor

Differential Amp Applications

©956B

Features

- Excellent in thermal equilibrium and especially suited for first-stage differential amp of DC amp
- Matched pair capability
- Low noise level

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Drain to source voltage	V_{DS}	40	V
Gate to drain voltage	V_{GDS}	-40	V
Gate current	I_G	10	mA
Drain current	I_D	20	mA
Allowable power dissipation	P_D	1 unit	200 mW
Total dissipation	P_T	400	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage temperature	T_{stg}	-40 to +125	$^\circ\text{C}$

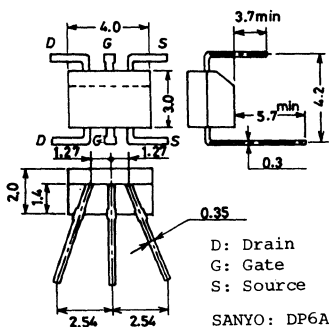
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Gate to drain breakdown voltage	$V_{(BR)GDS}$	$I_G = -100\mu\text{A}$	-40			V
Common source gate cutoff current	I_{GSS}	$V_{GS} = -20\text{V}, V_{DS} = 0\text{V}$			-1.0	nA
Drain current	I_{DSS}	$V_{DS} = 10\text{V}, V_{GS} = 0\text{V}, \text{Pulse}$	1.2*		12*	mA
Drain current ratio	—	$V_{DS} = 10\text{V}, I_{DSS \text{ low}}/I_{DSS \text{ high}}$	0.9			
Gate to source cutoff voltage	$V_{GS}(\text{off})$	$V_{DS} = 10\text{V}, I_D = 10\mu\text{A}$		-0.5		V
Gate to source voltage drop	ΔV_{GS}	$I_{V_{GS \text{ high}}} - V_{GS \text{ low}}, V_{DS} = 10\text{V}, I_D = 1\text{mA}$			30	mV
Forward transfer admittance	$ y_{fs} $	$V_{DS} = 10\text{V}, V_{GS} = 0\text{V}, f = 1\text{kHz}$		17		mS
Forward transfer admittance ratio	—	$V_{DS} = 10\text{V}, y_{fs} \text{ small}/y_{fs \text{ high}}$	0.9			
Input capacitance	C_{iss}	$V_{DS} = 10\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		13		pF
Reverse transfer capacitance	C_{rss}	$V_{DS} = 10\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		3		pF
Noise figure	NF (1)	$V_{DS} = 10\text{V}, V_{GS} = 0\text{V}, R_g = 1\text{k}\Omega, f = 100\text{kHz}$		1.0	3.0	dB
	NF (2)	$V_{DS} = 10\text{V}, V_{GS} = 0\text{V}, R_g = 1\text{k}\Omega, f = 1\text{kHz}$		0.6	1.5	dB
Output noise figure	V_{NO}	See specified test circuit. $V_{DS} = 10\text{V}, I_D = 1\text{mA}, R_g = 100\Omega, 100\text{dB (IHF-A) Amp}$		35		mV

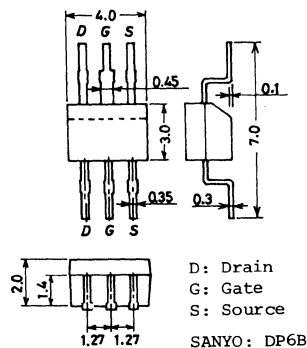
*: The 2SK332 is classified by I_{DSS} as follows:

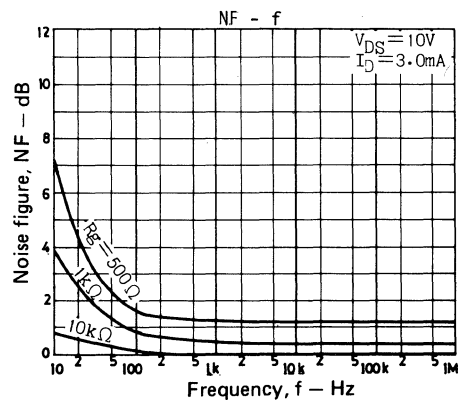
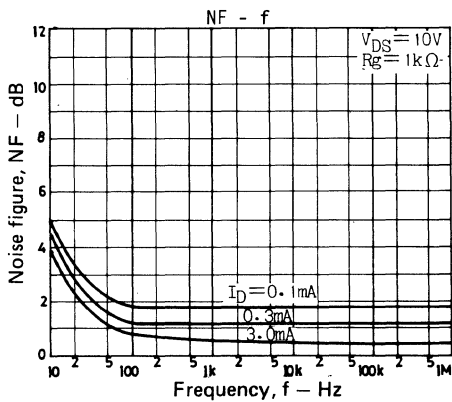
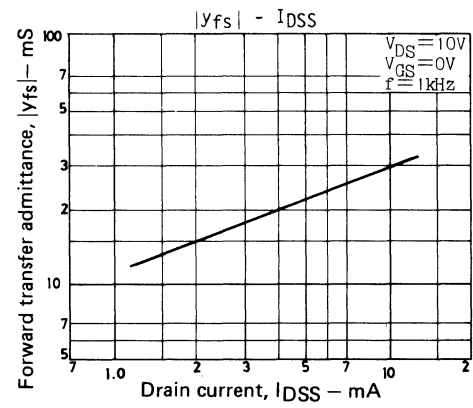
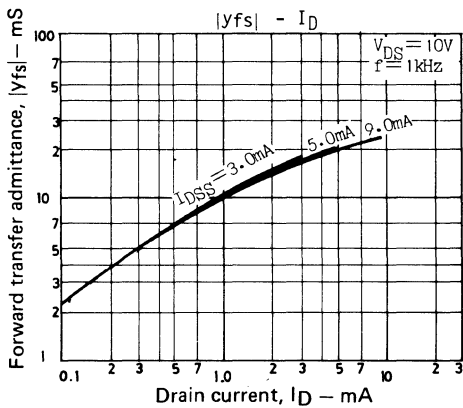
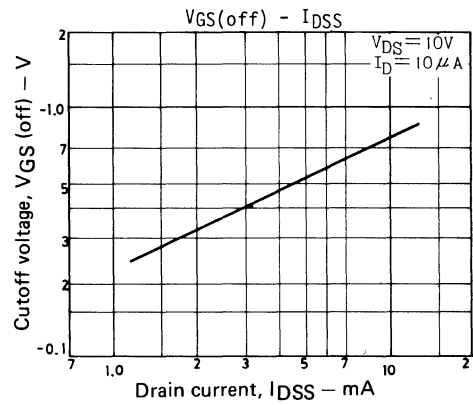
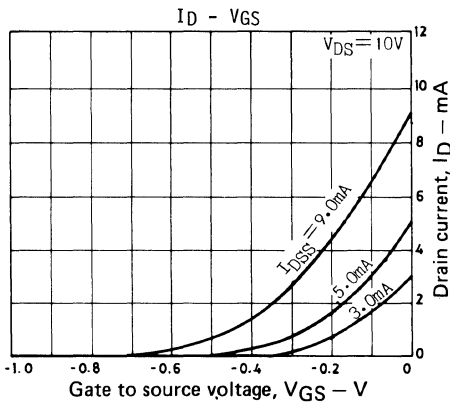
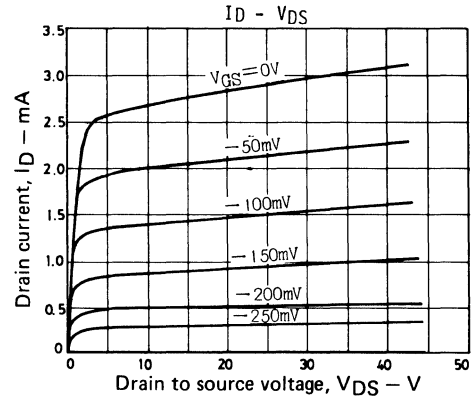
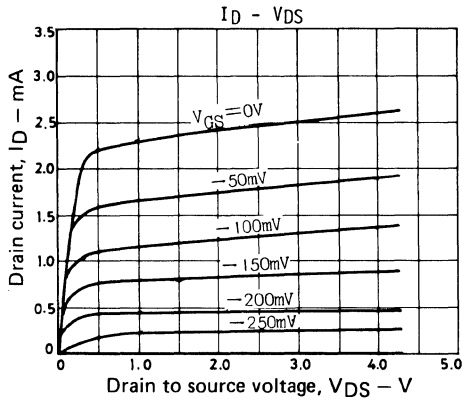
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2.5	E	6.0
5.0	F	12.0

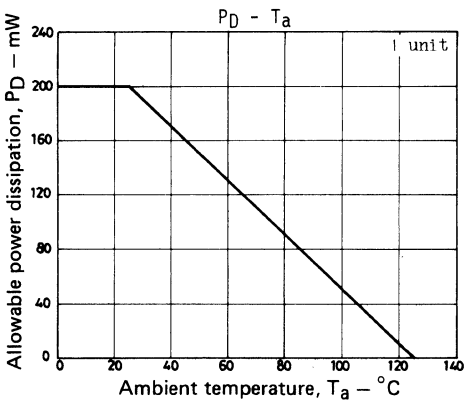
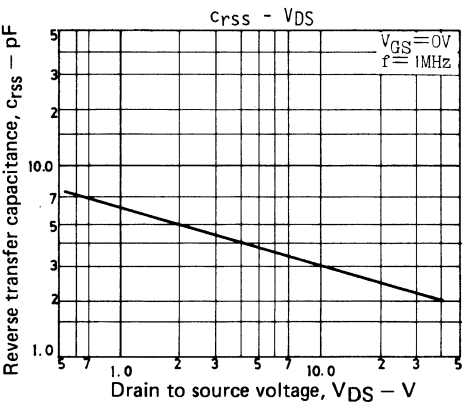
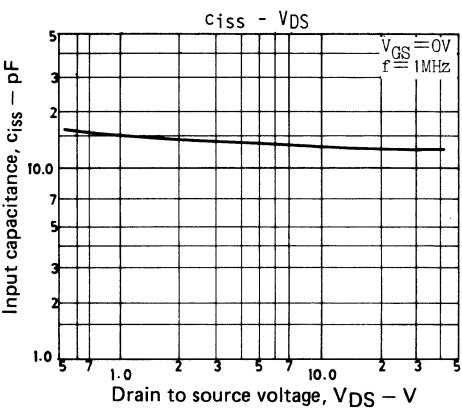
Case Outline 2027A
(unit: mm)



Case Outline 2028A
(unit: mm)







2SK333



2027A



2028A

N-Channel Junction
Silicon Field-Effect Transistor

Differential Amp Applications

©932A

Features:

- Especially suited for use in first stage of differential amp.
- High breakdown voltage and wide dynamic range
- Possible to form a matched pair

Absolute Maximum Ratings at Ta=25°C

			unit
Drain-source Voltage	V _{DSS}	80	V
Gate-Drain Voltage	V _{GDS}	-80	V
Gate Current	I _G	10	mA
Drain Current	I _D	20	mA
Allowable Power Dissipation	P _D	1 unit	200 mW
Total Power Dissipation	P _T	400	mW
Junction Temperature	T _j	125	°C
Storage Temperature	T _{stg}	-40 to +125	°C

Electrical Characteristics at Ta=25°C

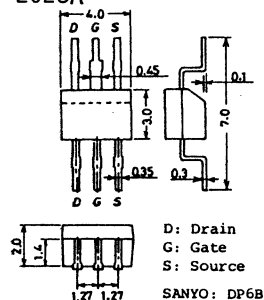
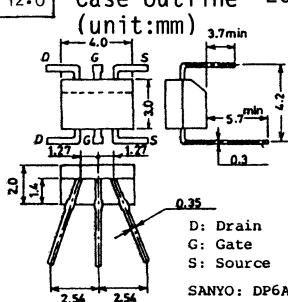
			min	typ	max	unit
G-D Breakdown Voltage	V(BR) _{GDS}	I _G =-100uA	-80			V
Gate Cutoff Current	I _{GSS}	V _G =-30V, V _D =0V			-1.0	nA
Drain Current	I _{DSS}	V _D =30V, V _G =0V, pulse	1.2*		12*	
Drain Current Ratio	-	V _D =30V, I _{DSSsmall} /I _{DSSlarge}	0.9			
Cutoff Voltage	V _G (off)	V _D =30V, I _D =10uA	-0.75	-3.0		V
G-S Voltage Difference	V _G	V _G large-V _G small, V _D =30V, I _D =1mA		30		mV
Forward Transfer Admittance	y _{fs}	V _D =30V, V _G =0V, f=1KHz	5	15		mS
Forward Transfer Admittance Ratio	-	V _D =30V, y _{fs} small/ y _{fs} large	0.9			
Input Capacitance	C _{iss}	V _D =30V, V _G =0V, f=1MHz		11		pF
Reverse Transfer Capa.	C _{rss}	V _D =30V, V _G =0V, f=1MHz		2.0		pF
Noise Figure	NF	V _D =30V, I _D =3mA, R _g =10kohm, f=1KHz		1.0		dB
D-G Leak Current	I _{GDL}	V _D =50V, I _D =1mA		0.5		nA
Output Noise Figure	V _{NO}	Refer to specified test circuit. V _D =10V, I _D =1mA, R _g =0ohm, 100dB (IHF-A) Amp		65		mV

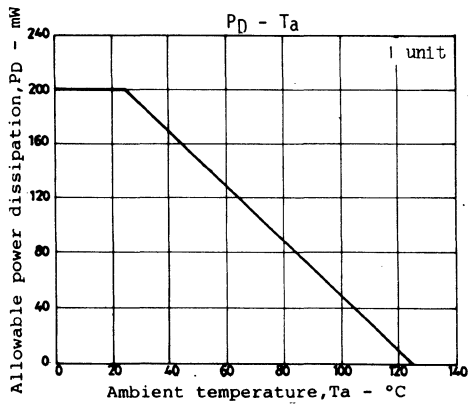
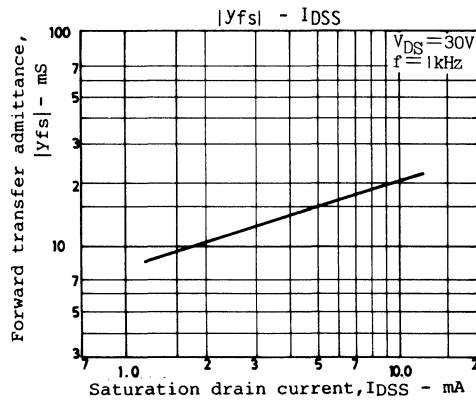
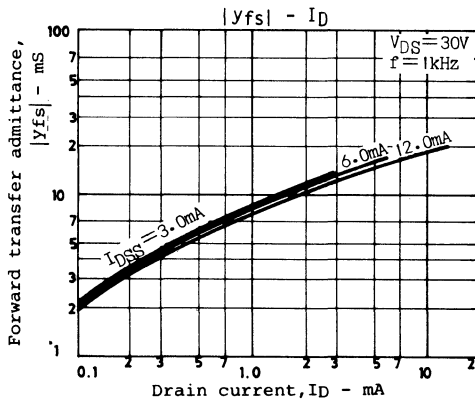
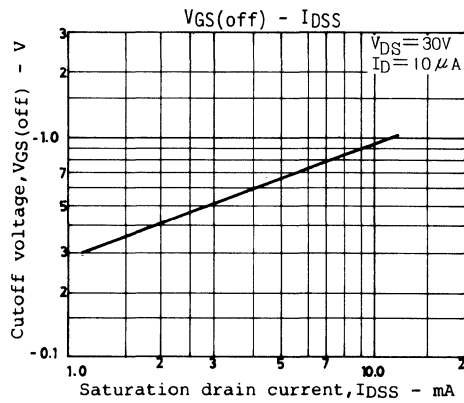
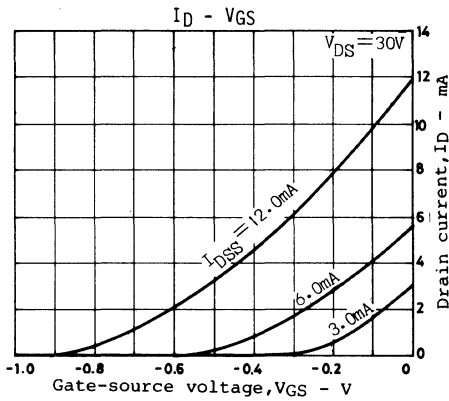
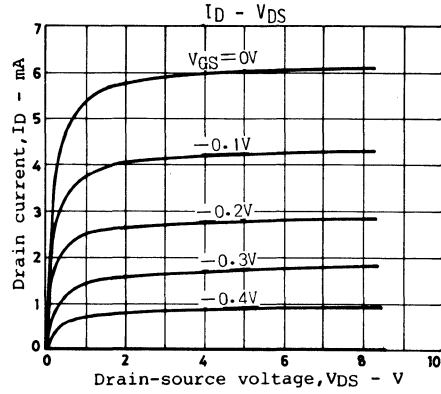
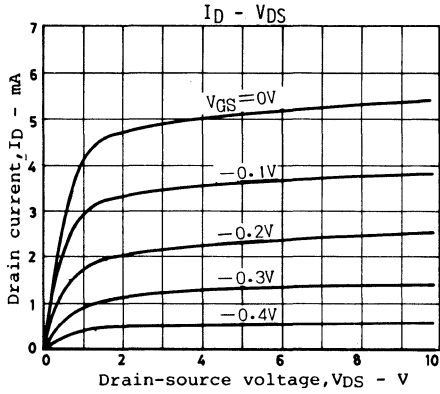
* The 2SK333 is classified by I_{DSS} small as follows.

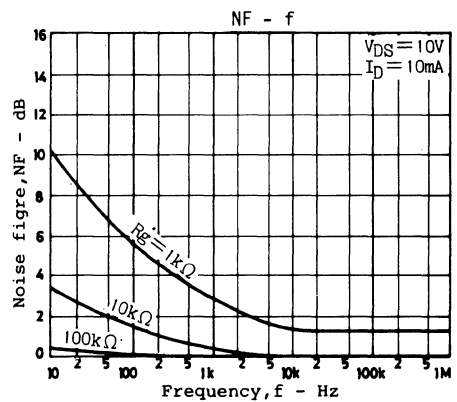
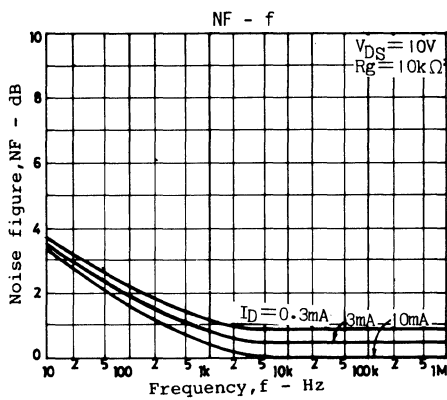
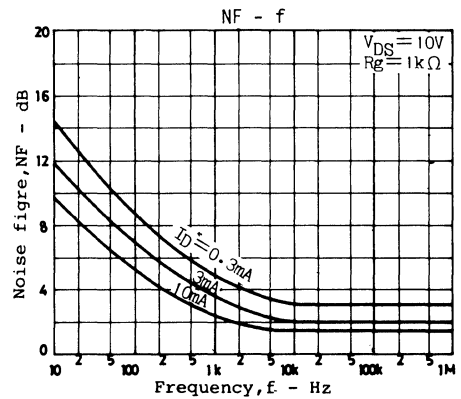
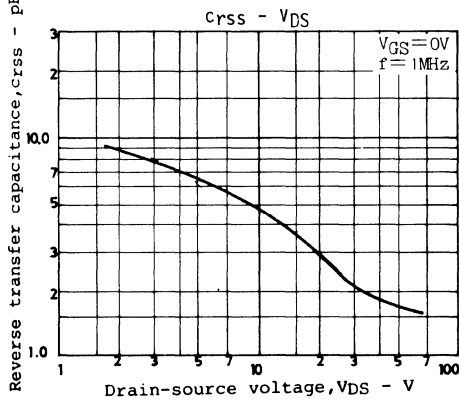
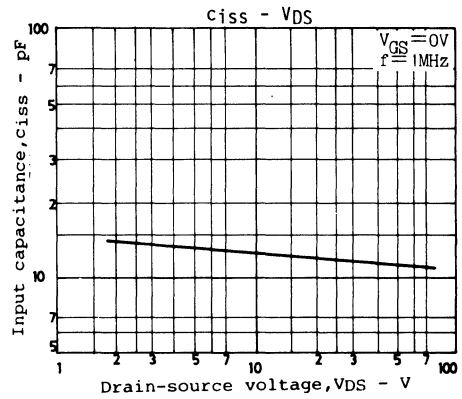
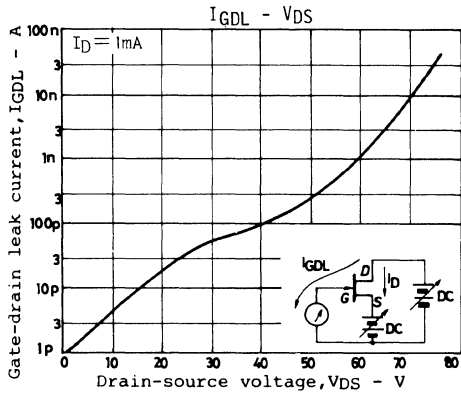
1.2	D	3.0	2.5	E	6.0	5.0	F	12.0
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Case Outline 2027A 2028A

(unit:mm)







2SK334



2025

N-Channel Junction
Silicon Field-Effect Transistor

Capacitor Microphone Applications

©933B

FEATURE

- * Because it has an ultra-compact outline, sets can be made compact.

ABSOLUTE MAXIMUM RATINGS/ $T_a = 25^\circ\text{C}$

			unit
Drain-gate current	V_{DGO}	-20	V
Gate current	I_G	10	mA
Allowable power dissipation	P_D	100	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage ambient temperature	T_{stg}	-40 ~ +125	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS/ $T_a = 25^\circ\text{C}$

		min	typ	max	unit
Drain current	I_{DSS}^* $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}$	60*		800*	μA

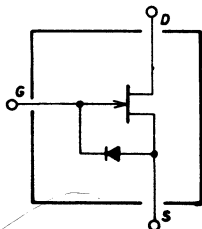
[$T_a = 25^\circ\text{C}$, $V_{CC} = 4.5\text{ V}$, $R_D = 680\ \Omega$, $C_{in} = 15\text{ pF}$, in a specified test circuit (conforming with application circuit)].

			min	typ	max	unit
Transmission loss	G_V			-5		dB
Transmission loss voltage-drop characteristics	$\Delta G_V V$	$V_{CC} = 4.5 \sim 1.5\text{ V}, f = 1\text{ kHz}$ $v_i = 10\text{ mV}$			-3	dB
Transmission loss frequency characteristics	$\Delta G_V f$	$f = 1\text{ k} \sim 110\text{ Hz}, v_i = 10\text{ mV}$			-1	dB
Input impedance	z_i	$f = 1\text{ kHz}$	20			$\text{M}\Omega$
Output noise voltage	V_{NO}	$v_i = 0, A\text{-curve}$			-110	dB

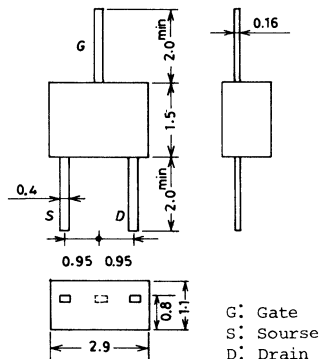
* 2SK334 is graded as follows by drain current I_{DSS} : (unit: mm)

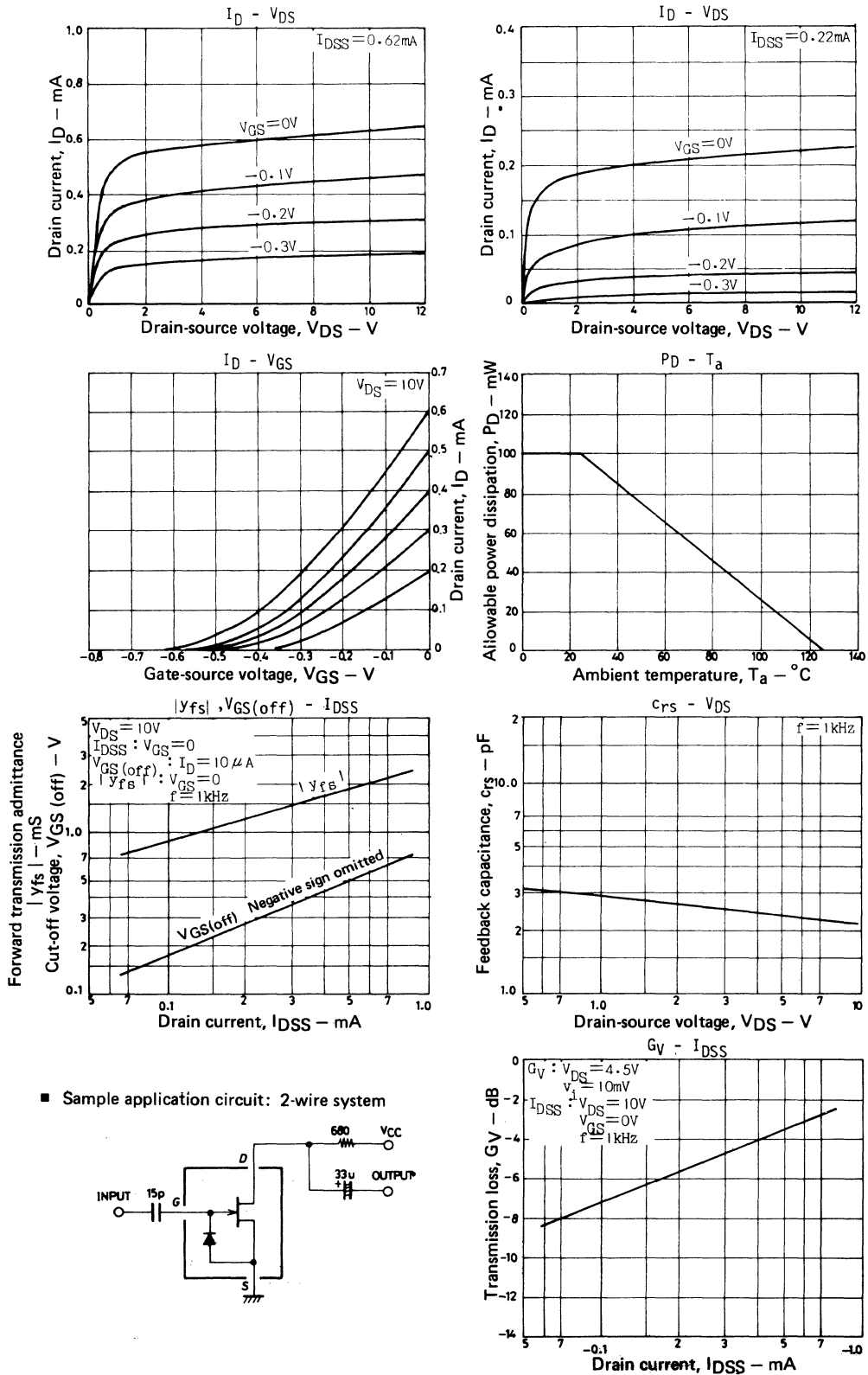
60	N11	180	150	N12	300	250	N13	450	400	N14	800
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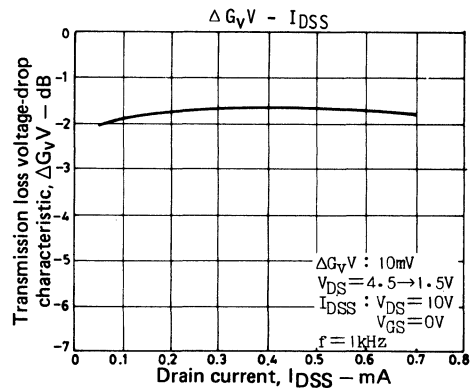
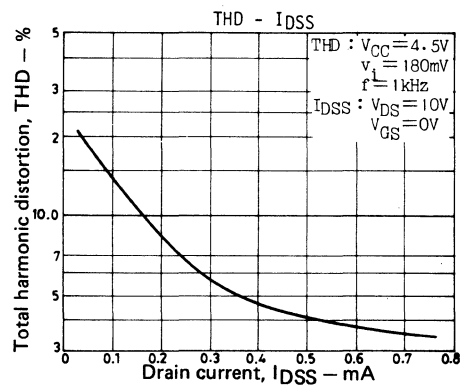
Equivalent circuit



Case Outline 2025 (unit: mm)









N-Channel Junction Silicon Field-Effect Transistor

©1432

- . Especially suited for use in audio, telephone capacitor microphones.
- . High yfs.
- . Excellent voltage characteristic.
- . Adoption of FBET process.

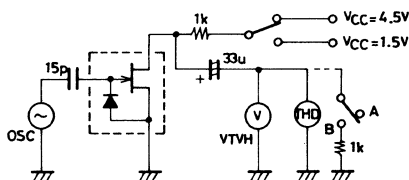
Gate-Drain Voltage	V_{GD0}	-20	V
Gate Current	I_G	10	mA
Allowable Power Dissipation	P_D	100	mW
Junction Temperature	T_j	125	°C
Storage Temperature	T_{stg}	-55 to +125	°C

Drian Current	I_{DSS}	$V_{DS}=5V, V_{GS}=0$	60*	800*	μA
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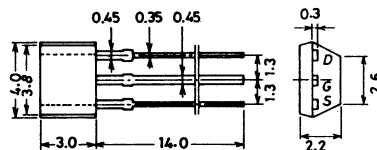
60	J	180	150	K	300	250	L	500	400	M	800
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[Ta=25°C, V _{CC} =4.5V, R _L =1kohm, cin=15pF, Specified Test Circuit]				min	typ	max	unit
Transmission Loss	G _V	f=1kHz, V _{in} =100mV		-3.5			dB
Reduced Voltage Characteristic	ΔG _{VV}	f=1kHz, V _{in} =100mV V _{CC} =4.5 to 1.5V				-3	dB
Frequency Response	ΔG _{Vf}	f=1kHz to 110Hz, V _{in} =100mV				-1	dB
Input Impedance	Z _{in}	f=1kHz	18.0				Mohm
Output Impedance	Z _o	f=1kHz				1.0	kohm
Total Harmonic Distortion	THD	f=1kHz, V _{in} =100mV		3			%
Output Noise Voltage	V _{NO}	V _{in} =0, A curve				-110	dB

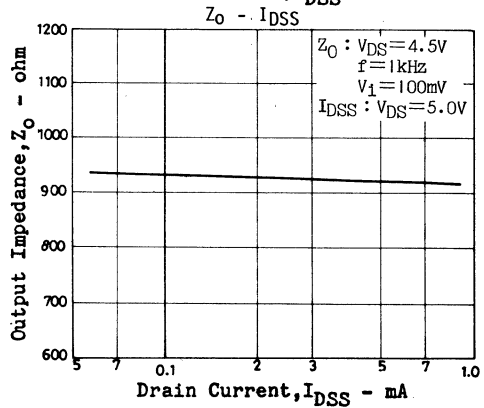
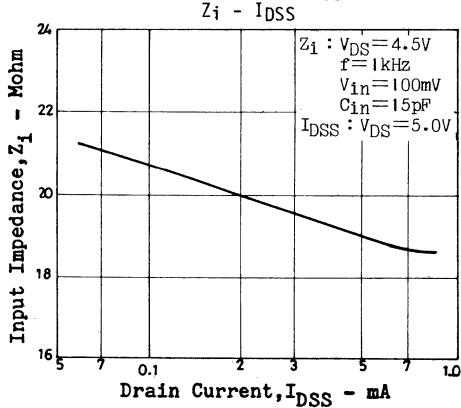
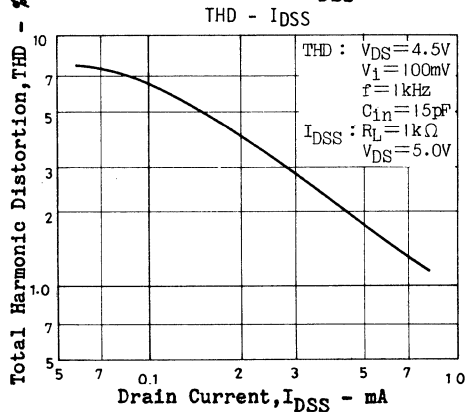
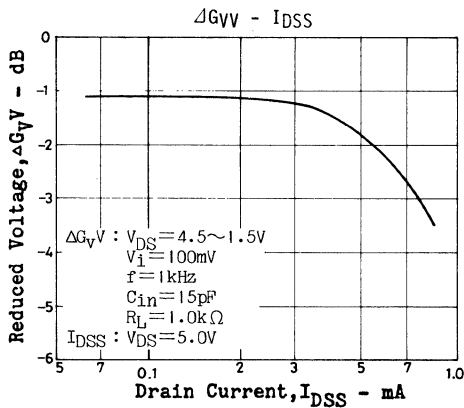
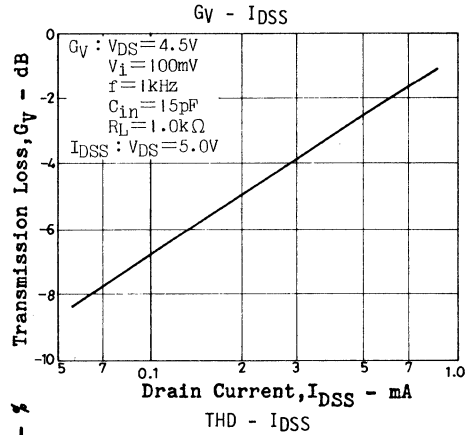
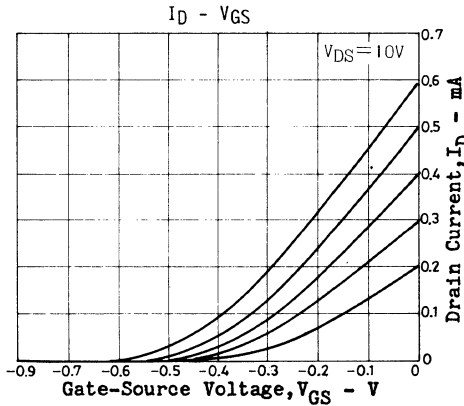
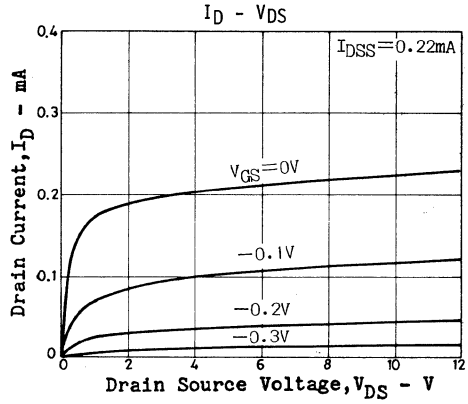
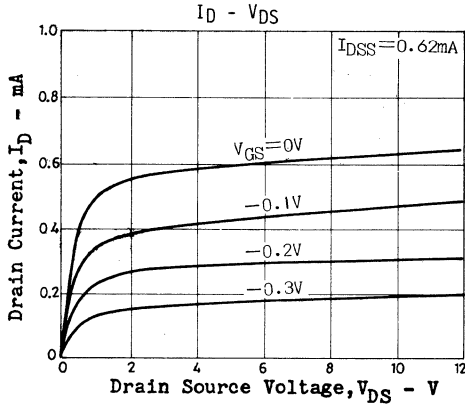
Transmission loss
Frequency response
Distortion
Reduced voltage characteristic

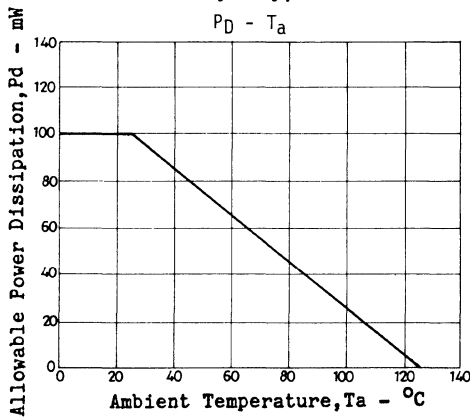
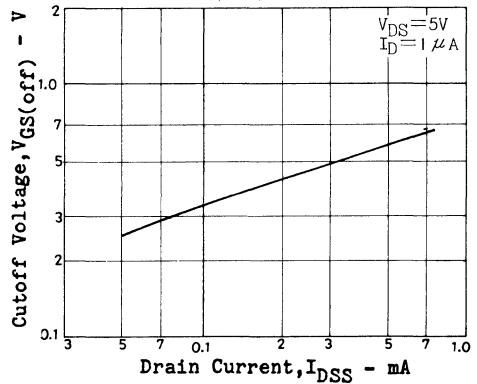
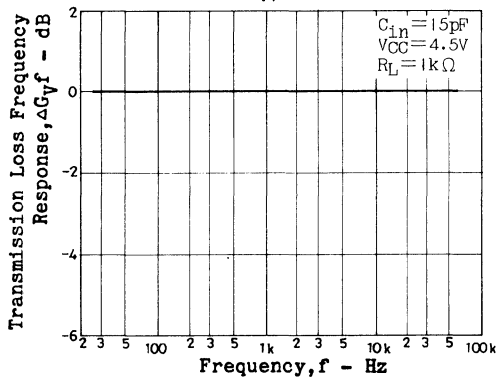
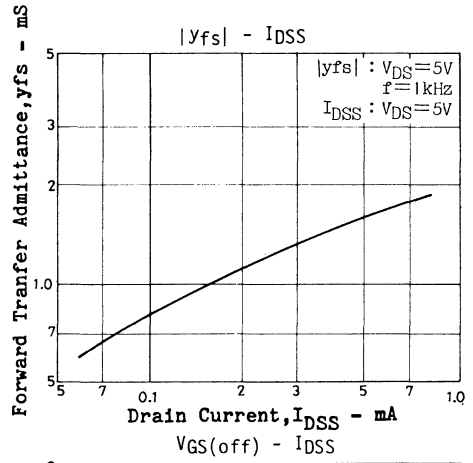
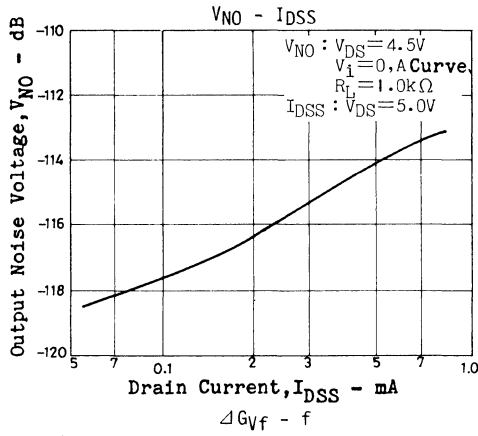


Case Outline 2037
(unit:mm)

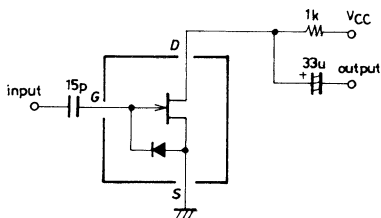


D: Drain
G: Gate
S: Source
SANYO: SP





Sample Application Circuit: 2-wire type





N-Channel Junction Silicon Field-Effect Transistor

(E)1393

- . Especially suited for use in audio, telephone capacitor microphones.
- . High μ fs.
- . Excellent voltage characteristic.

Gate-Drain Voltage	V_{GD0}	-20	V
Gate Current	I_G	10	mA
Allowable Power Dissipation	P_D	100	mW
Junction Temperature	T_J	125	°C
Storage Temperature	T_{stg}	-55 to +125	°C

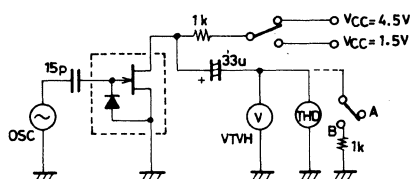
Drain Current	I_{DSS}	$V_{DS}=5V, V_{GS}=0$	60*	800*	μA
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* The 2SK377 is classified by drain current I_{DSS} as follows (unit:mm):

60	J	180	150	K	300	250	L	500	400	M	800
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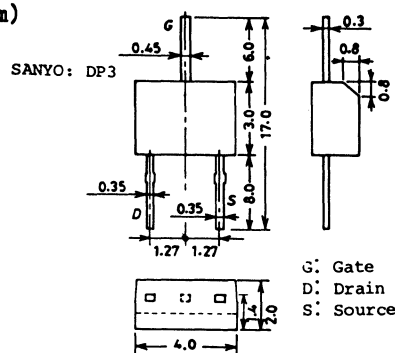
Transmission Loss	G_V	$f=1\text{kHz}, V_{in}=100\text{mV}$	-3.5	dB
Reduced Voltage Characteristic	ΔG_{VV}	$f=1\text{kHz}, V_{in}=100\text{mV}$ $V_{CC}=4.5$ to 1.5V	-3	dB
Frequency Response	ΔG_{VF}	$f=1\text{kHz to } 110\text{Hz}, V_{in}=100\text{mV}$	-1	dB
Input Impedance	Z_{in}	$f=1\text{kHz}$	18.0	Mohm
Output Impedance	z_o	$f=1\text{kHz}$	1.0	kohm
Total Harmonic Distortion	THD	$f=1\text{kHz}, V_{in}=100\text{mV}$	3	%
Output Noise Voltage	V_{NO}	$V_{in}=0, A$ curve	-110	dB

Transmission loss
Frequency response
Distortion
Reduced voltage characteristic

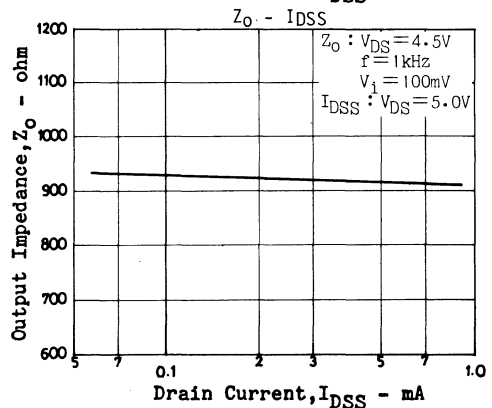
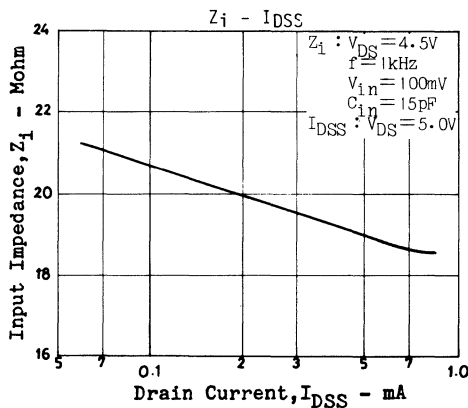
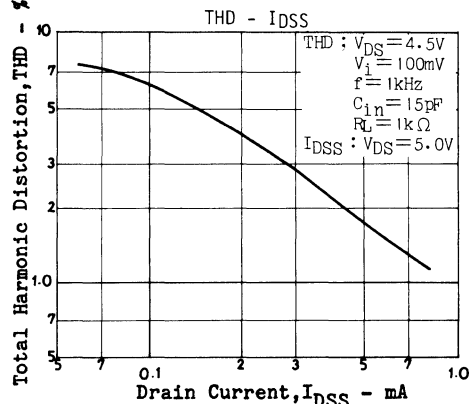
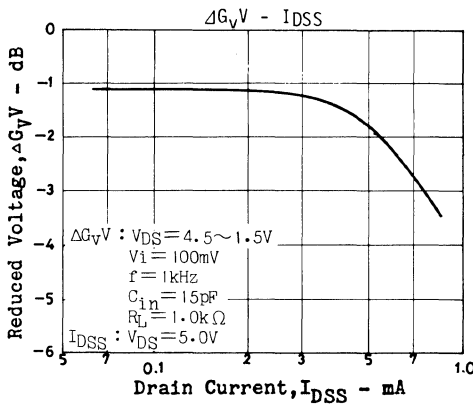
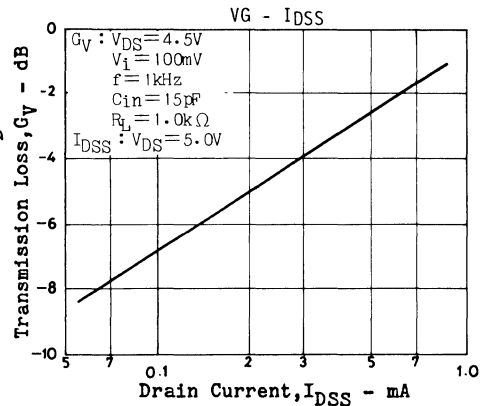
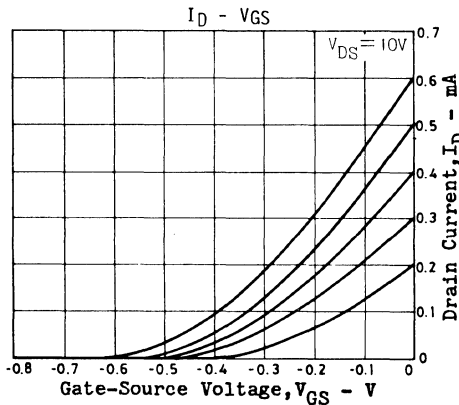
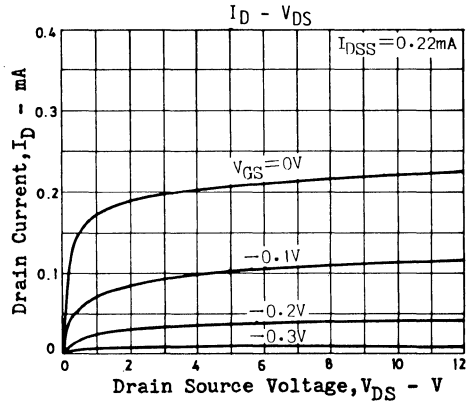
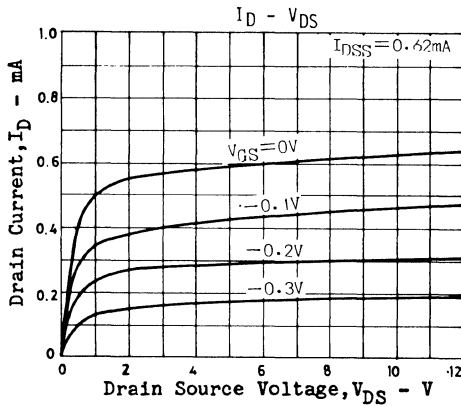


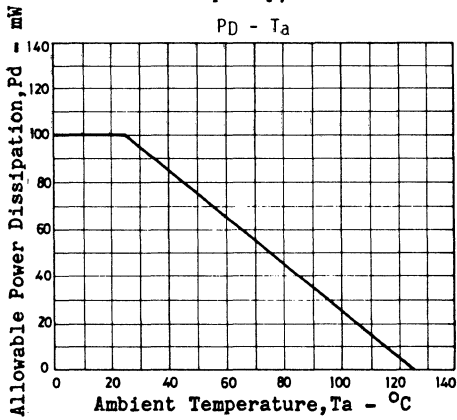
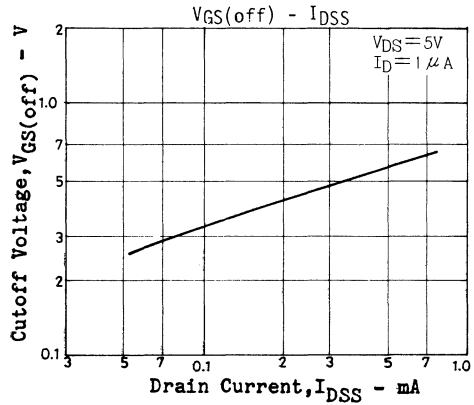
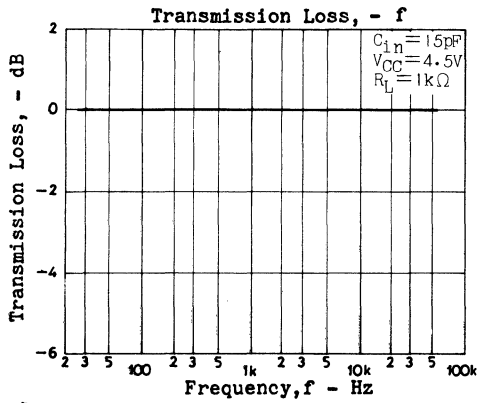
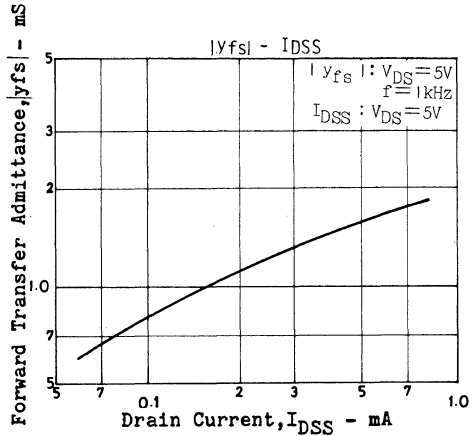
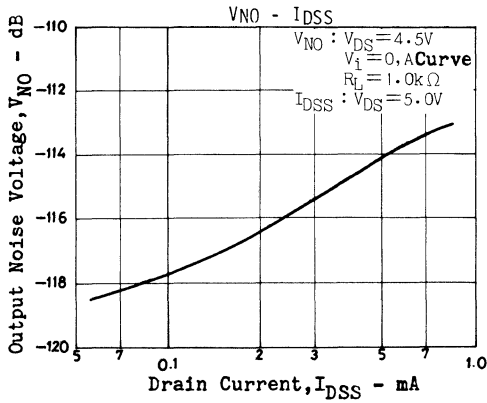
For output impedance

(unit:mm)

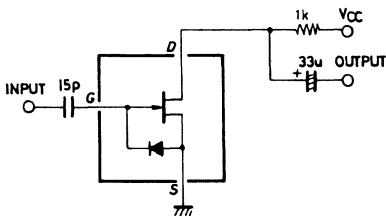


G: Gate
D: Drain
S: Source





Sample Application Circuit: 2-wire type



2SK404



2034

N-Channel Junction
Silicon Field-Effect Transistor

Low Frequency, High Frequency General-Purpose Amp Applications

©1403

Features

- Large $|y_{fs}|$
- Low noise
- Small C_{rss}

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Drain to source voltage	V_{DSS}	20	V
Gate to drain voltage	V_{GSS}	-20	V
Gate current	I_G	10	mA
Drain current	I_D	20	mA
Allowable power dissipation	P_D	200	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 to +125	$^\circ\text{C}$

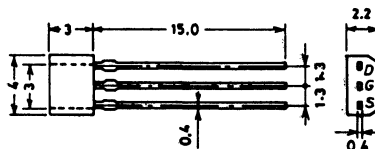
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Gate to drain breakdown voltage	$V_{(BR) GSS}$	$I_G = -10\mu\text{A}$	-20			V
Common source gate cutoff current	I_{GSS}	$V_{GS} = -10\text{V}, V_{DS} = 0\text{V}$			-1.0	nA
Gate to source cutoff voltage	$V_{GS}(\text{off})$	$V_{DS} = 5\text{V}, I_D = 10\mu\text{A}$		-0.8	-2.0	V
Drain current	I_{DSS}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}$	1.2*		12.0*	mA
Forward transfer admittance	$ y_{fs} $	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{kHz}$	5.0	10		mS
Input capacitance	C_{iss}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		7.0		pF
Reverse transfer capacitance	C_{rss}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		1.8		pF
Noise figure	NF	$V_{DS} = 5\text{V}, I_D = 1\text{mA},$ $R_g = 1\text{k}\Omega, f = 1\text{kHz}$		1.5		dB

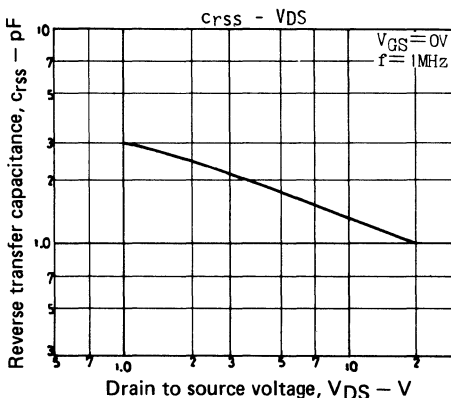
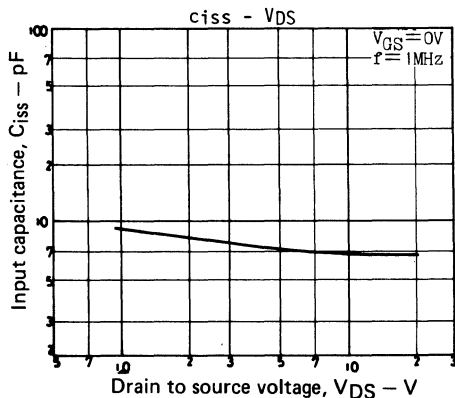
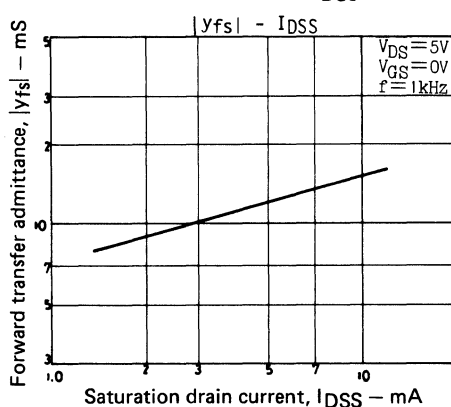
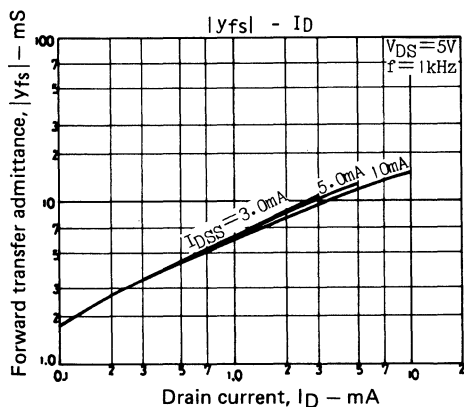
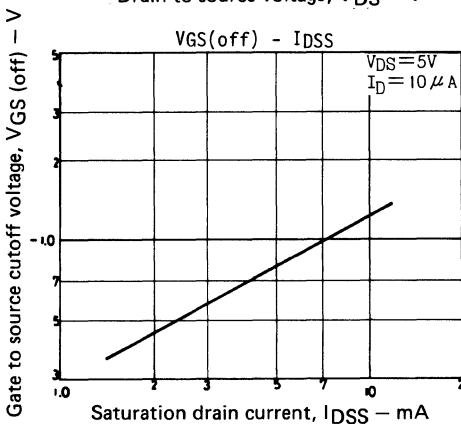
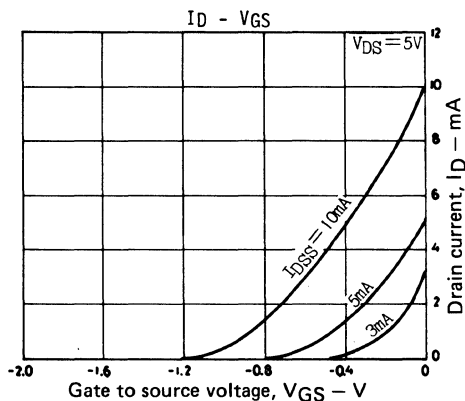
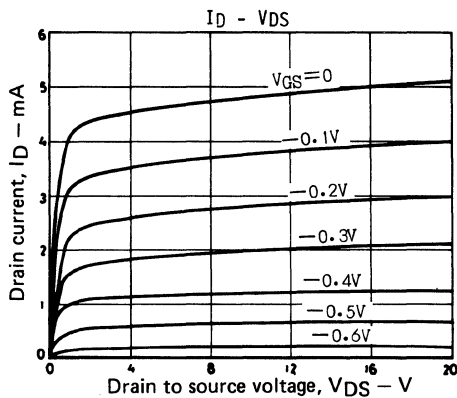
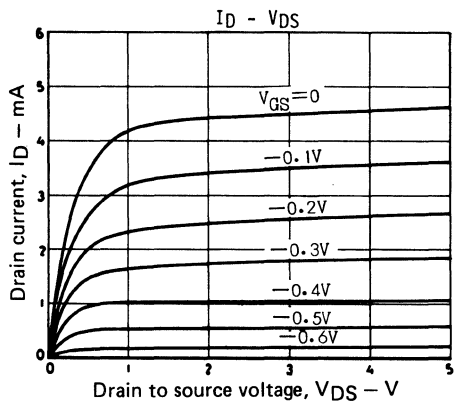
*: The 2SK404 is classified by $V_{DS} = 5\text{V}$ as follows:

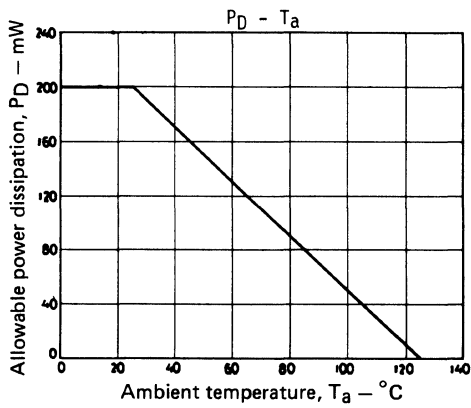
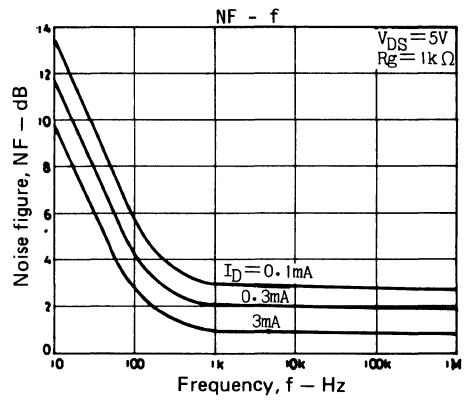
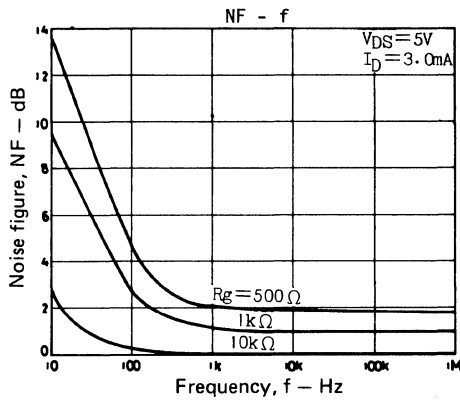
1.2	D	3.0	2.5	E	6.0	5.0	F	12.0
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Case Outline 2034
(unit: mm)



D: Drain
G: Gate
S: Source
SANYO: SPA





2SK427



2034

N-Channel Junction
Silicon Field-Effect Transistor

AM Tuner RF Amp Applications

©1404

Use

- AM tuner RF amp, low-noise amp

Features

- Large $|y_{fs}|$
- Very low noise figure
- Small C_{rss}

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

Drain to source voltage	V_{DS}	15	unit
Gate to drain voltage	V_{GDS}	-15	V
Gate current	I_G	10	mA
Drain current	I_D	20	mA
Power dissipation	P_D	200	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ~ +125	$^\circ\text{C}$

Electrical Characteristics/ $T_a = 25^\circ\text{C}$

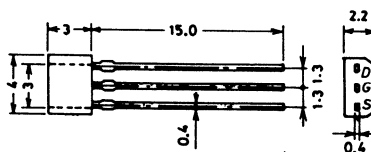
			min	typ	max	unit
Gate to drain breakdown voltage	$V(BR)_{GDS}$	$I_G = -10\mu\text{A}, V_{DS} = 0\text{V}$	-15			V
Common source gate cutoff current	I_{GSS}	$V_{GS} = -10\text{V}, V_{DS} = 0\text{V}$			-1.0	nA
Gate to source cutoff voltage	$V_{GS(off)}$	$V_{DS} = 5\text{V}, I_D = 100\mu\text{A}$		-0.5	-1.5	V
Drain current (gate-source shorted)	I_{DSS}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}$	1.2*		12.0*	mA
Forward transfer admittance	$ y_{fs} $	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{kHz}$	8.0	17		mS
Input capacitance	C_{iss}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		7.0		pF
Feedback capacitance	C_{rss}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		2.0		pF
Noise figure	NF	$V_{DS} = 5\text{V}, I_o = 1\text{mA}$ $R_g = 1\text{k}\Omega, f = 1\text{kHz}$		1.5		dB

*:The 2SK427 is classified by I_{DSS} as follows:

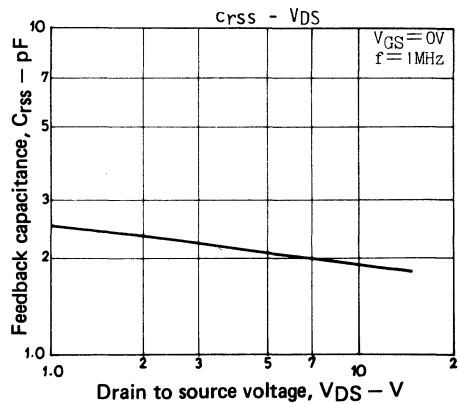
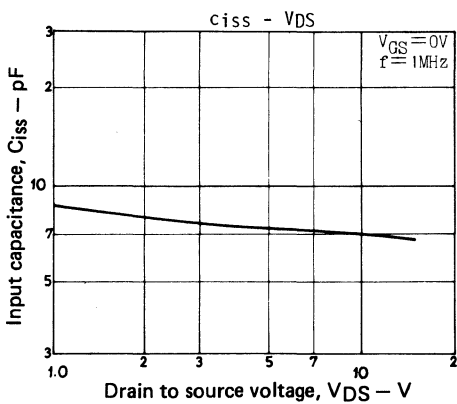
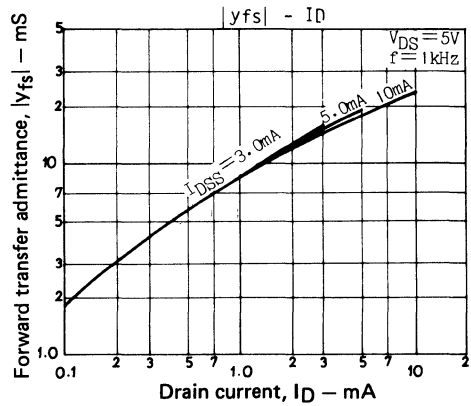
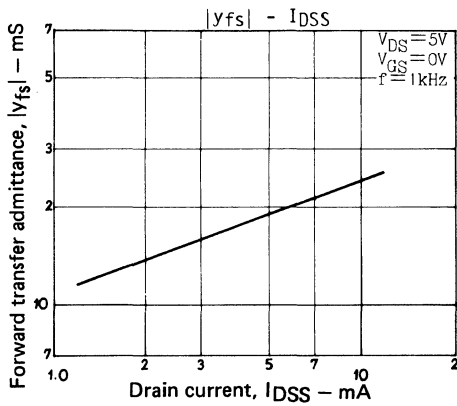
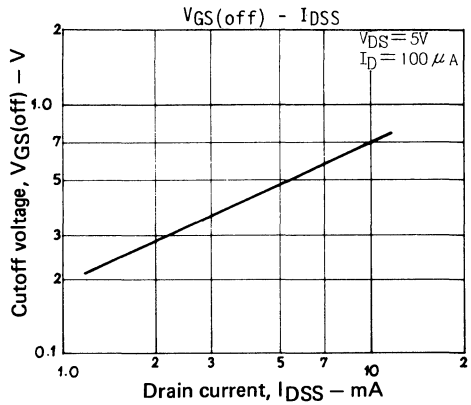
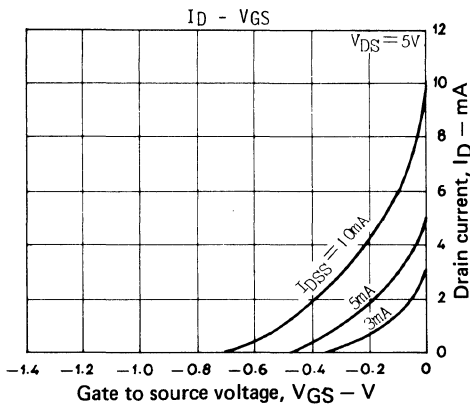
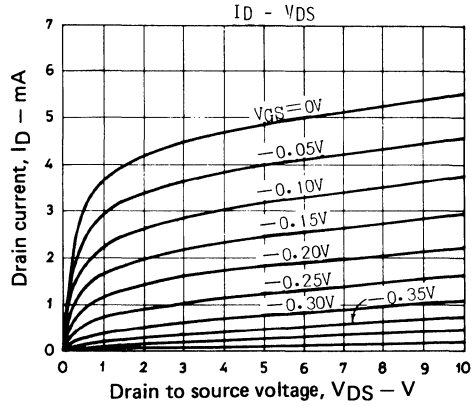
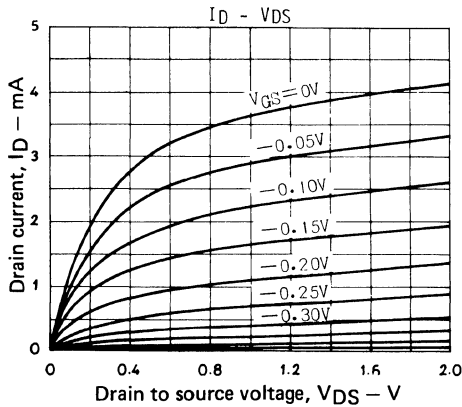
1.2	P	2.1	1.7	Q	3.0	2.5	R	4.2
3.5	S	6.0	5.0	T	8.5	7.3	U	12.0

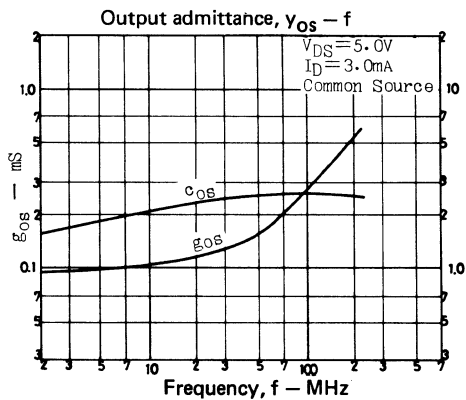
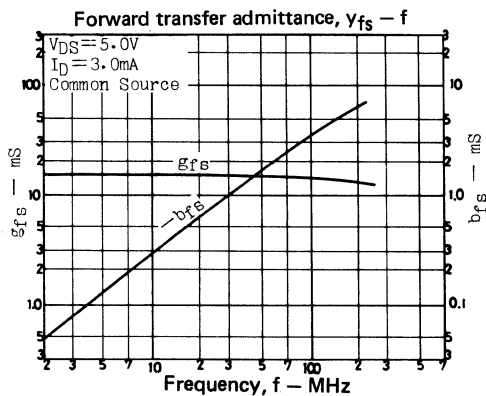
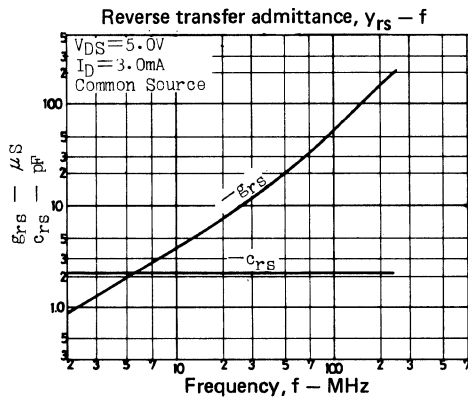
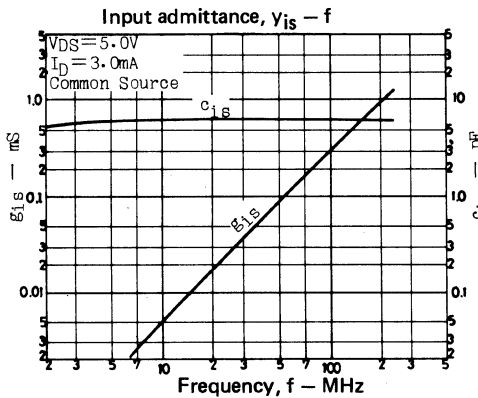
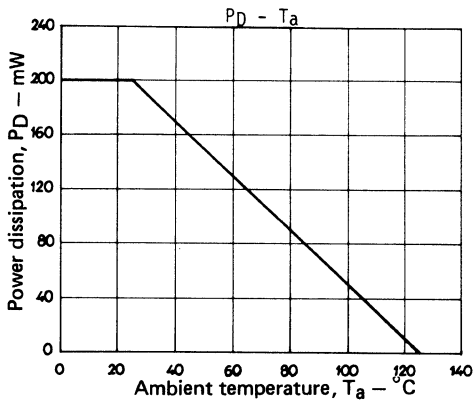
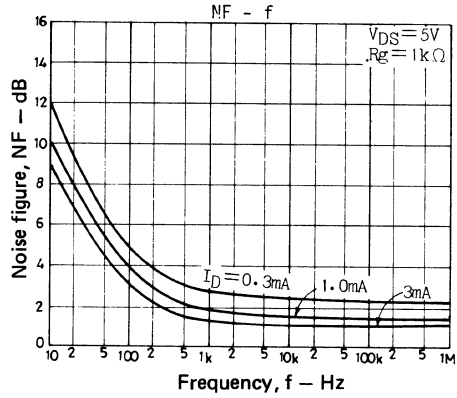
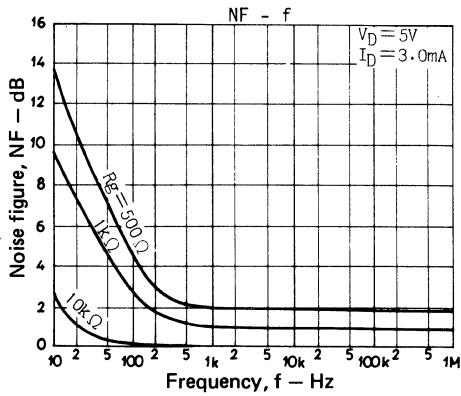
Case Outline 2034

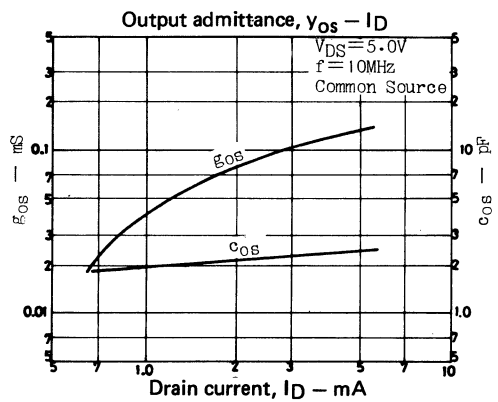
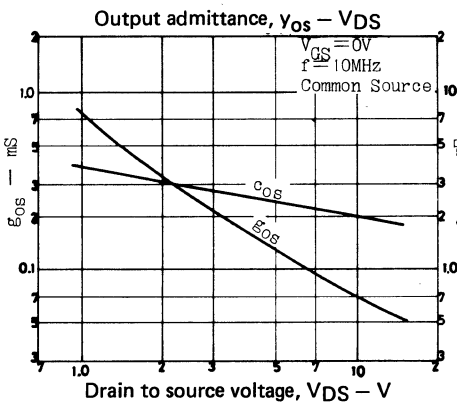
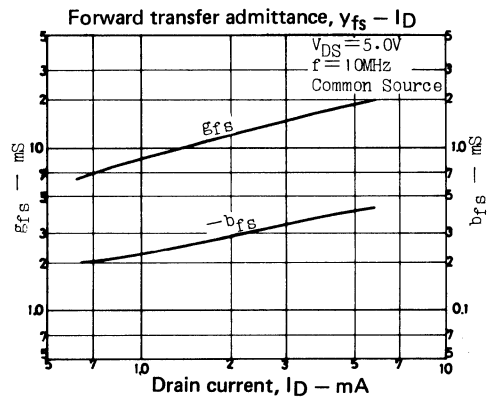
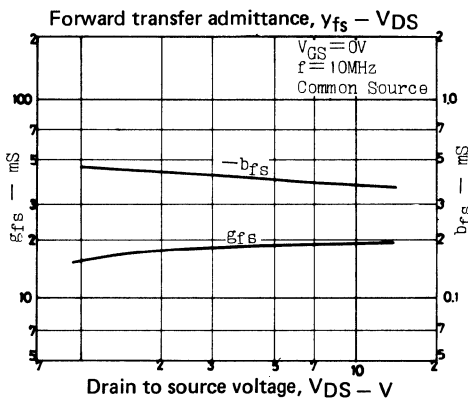
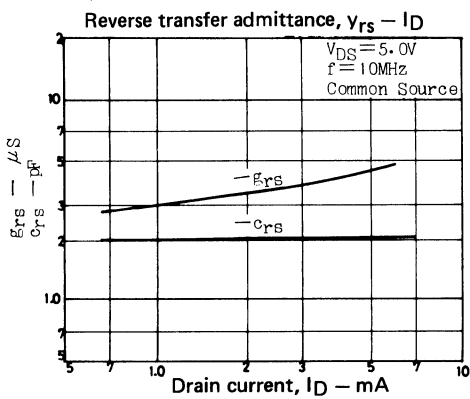
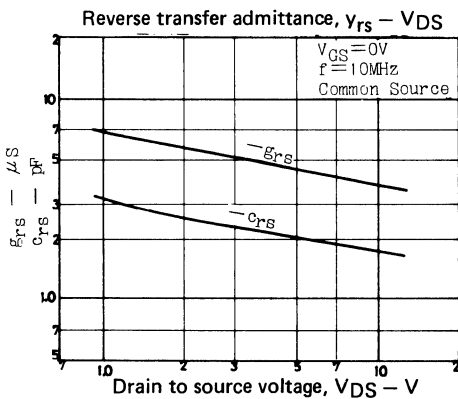
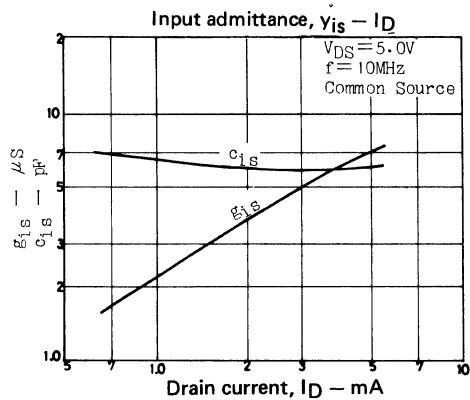
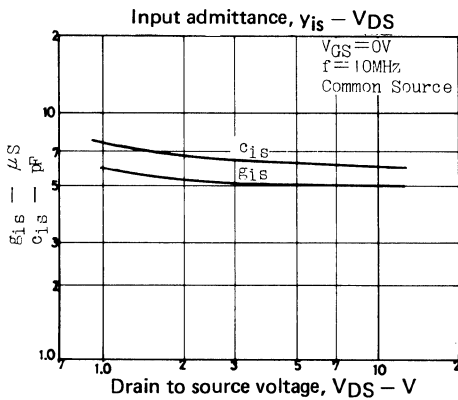
(unit: mm)

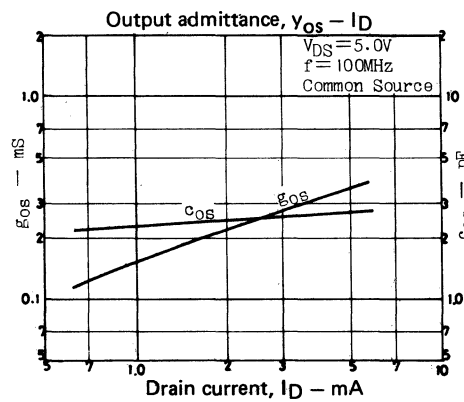
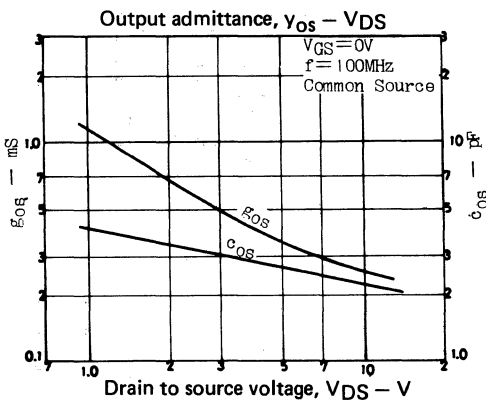
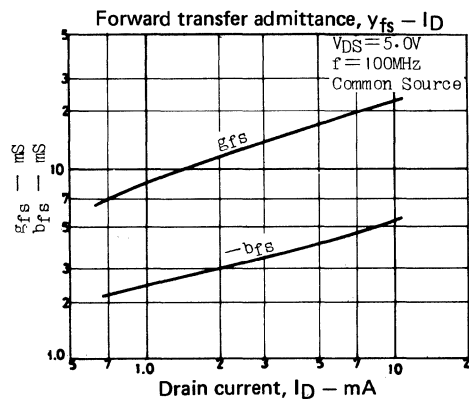
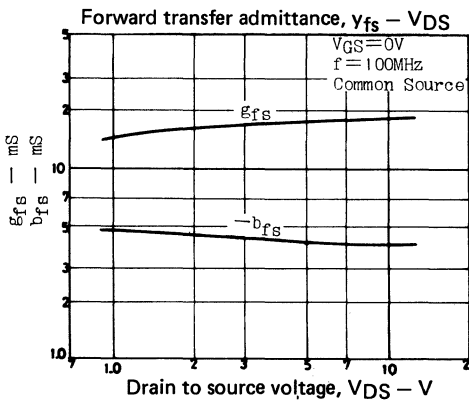
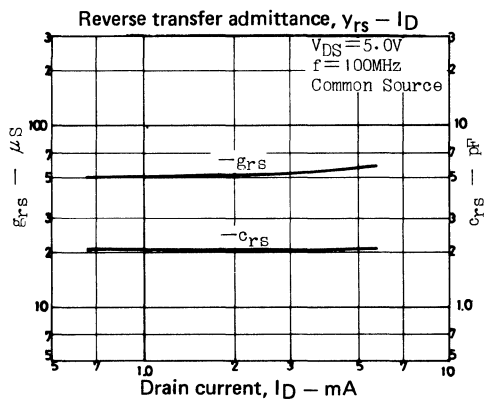
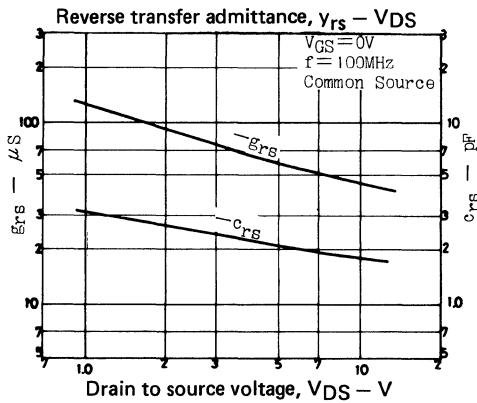
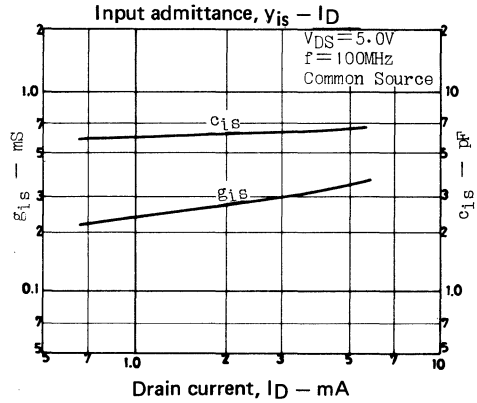
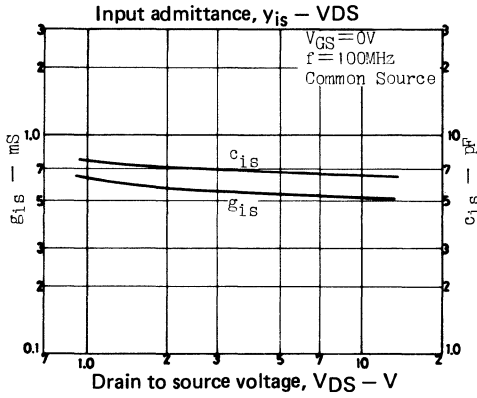


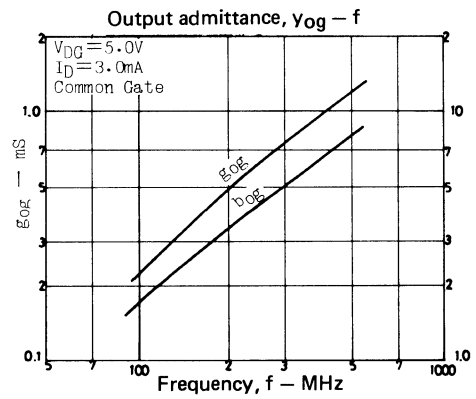
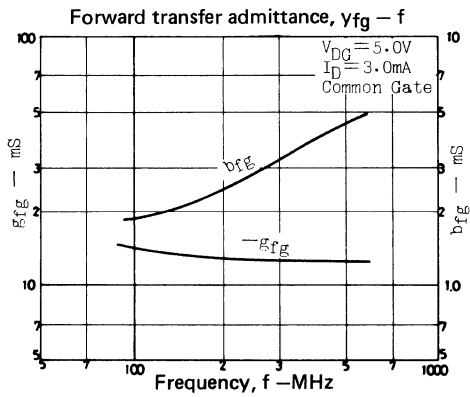
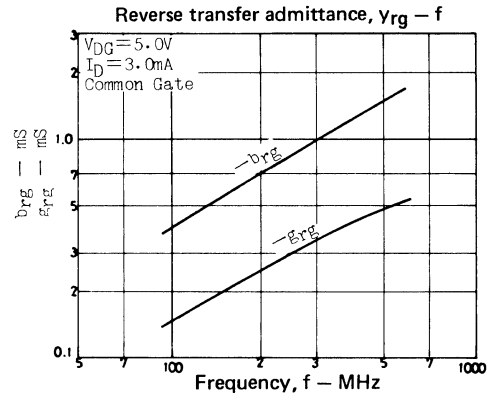
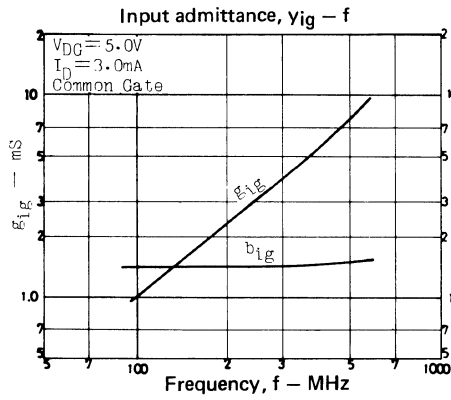
D: Drain
G: Gate
S: Source
SANYO: SPA











2SK436



2021

N-Channel Junction
Silicon Field-Effect Transistor

High Frequency, Low Frequency, General-Purpose Amp Applications

©1405

Use

- AM tuner RF amp, low-noise amp

Features

- Large $|y_{fs}|$
- Very low noise figure
- Small C_{rss}
- Very small-sized package permitting sets to be small-sized, slim

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

Drain to source voltage	V_{DSS}	15	unit
Gate to drain voltage	V_{GDS}	-15	V
Gate current	I_G	10	mA
Drain current	I_D	20	mA
Power dissipation	P_D	150	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ~ +125	$^\circ\text{C}$

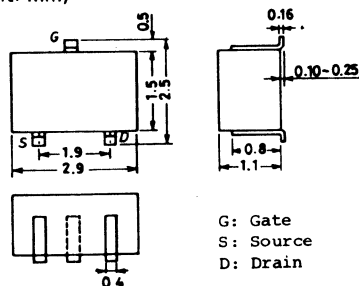
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

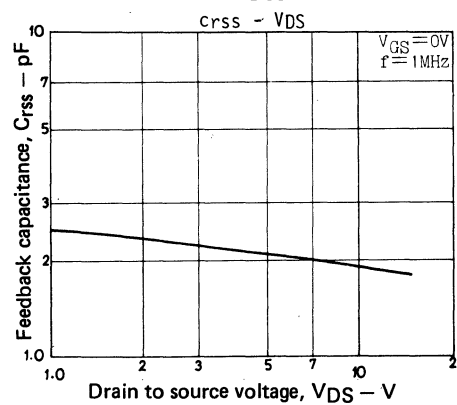
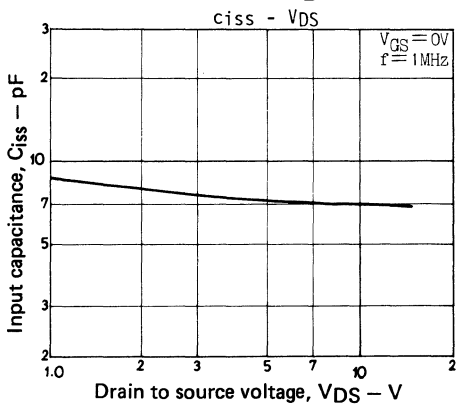
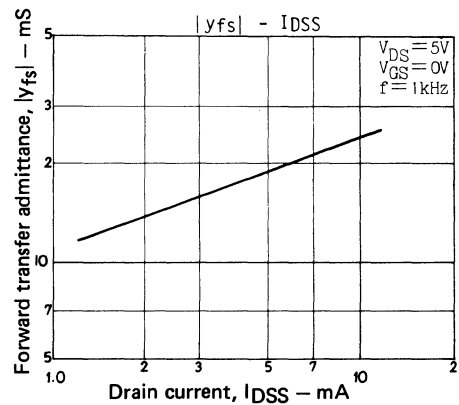
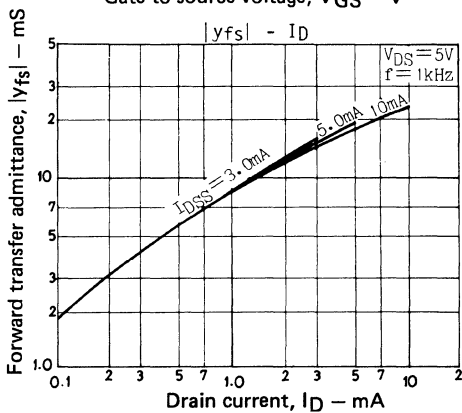
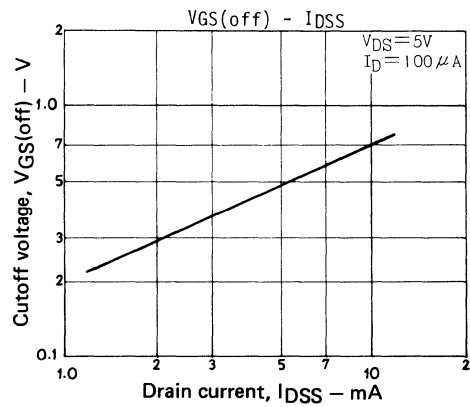
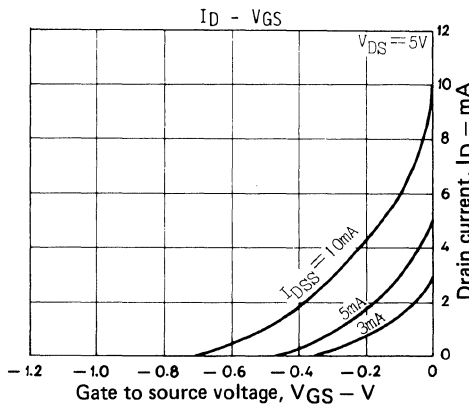
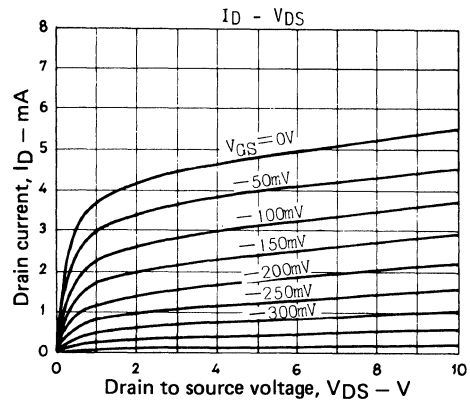
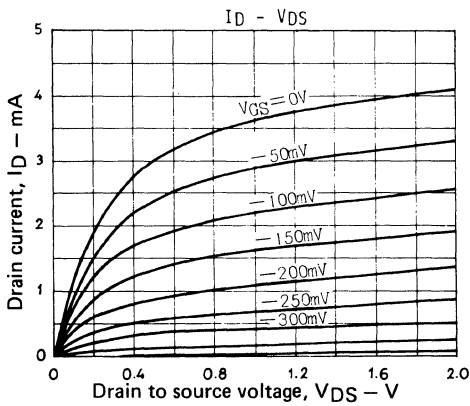
			min	typ	max	unit
Gate to drain breakdown voltage	$V_{(BR)GDS}$	$I_G = -10\mu\text{A}, V_{DS} = 0\text{V}$	-15			V
Common source gate cutoff current	I_{GSS}	$V_{GS} = -10\text{V}, V_{DS} = 0\text{V}$			-1.0	nA
Gate to source cutoff voltage	$V_{GS(off)}$	$V_{DS} = 5\text{V}, I_D = 100\mu\text{A}$		-0.5	-1.5	V
Drain current (gate-source shorted)	I_{DSS}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}$	1.2*		12.0*	mA
Forward transfer admittance	$ y_{fs} $	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{kHz}$	8.0	17		mS
Input capacitance	C_{iss}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		7.0		pF
Feedback capacitance	C_{rss}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		2.0		pF
Noise figure	NF	$V_{DS} = 5\text{V}, R_g = 1\text{k}\Omega, I_D = 1\text{mA}, f = 1\text{kHz}$		1.5		dB

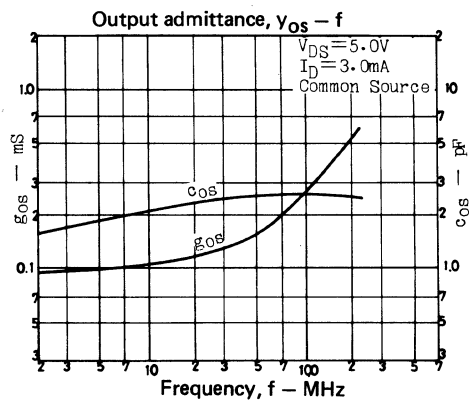
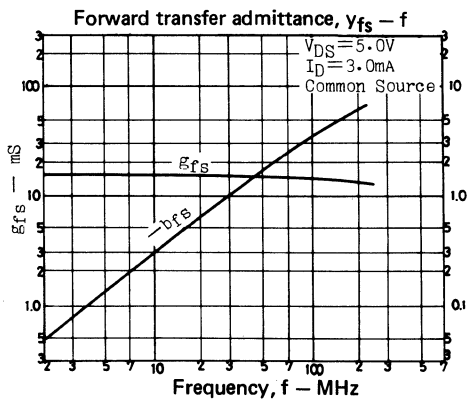
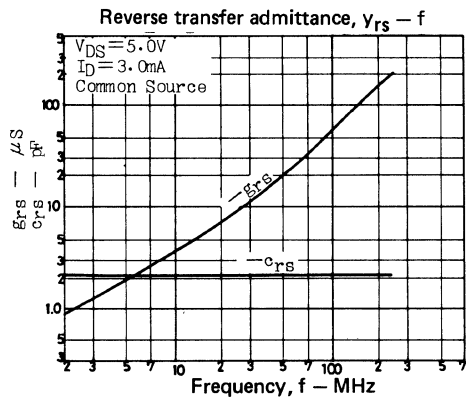
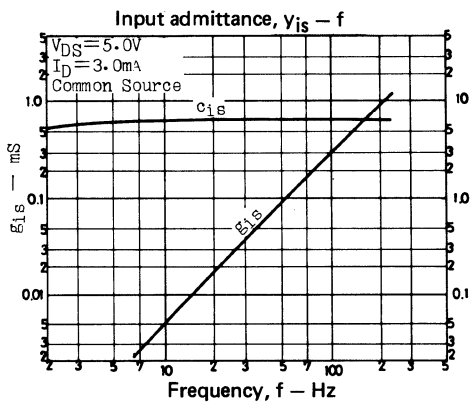
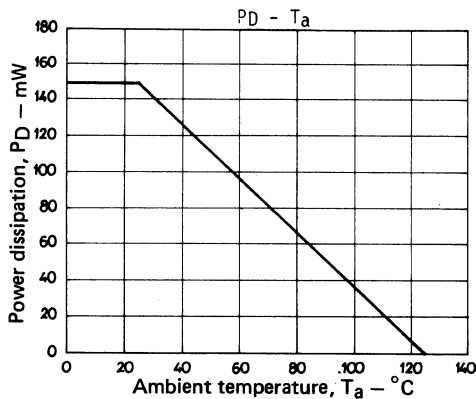
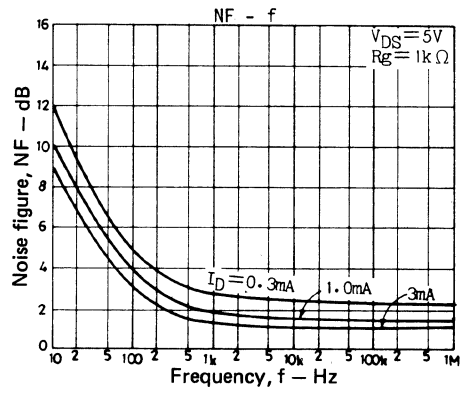
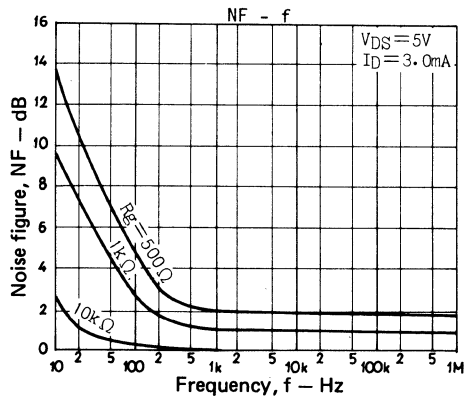
*:The 2SK436 is classified by I_{DSS} as follows:

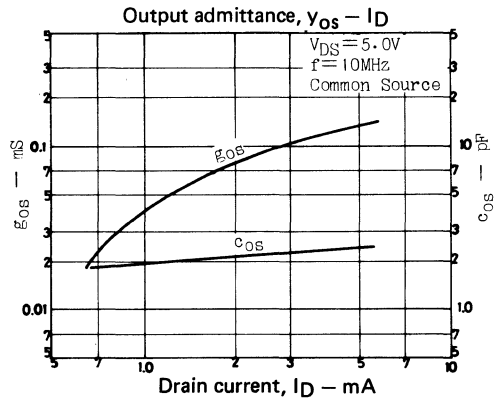
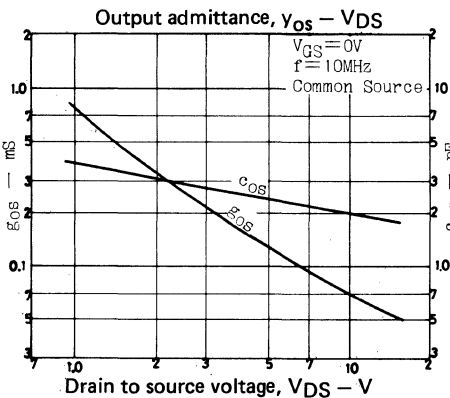
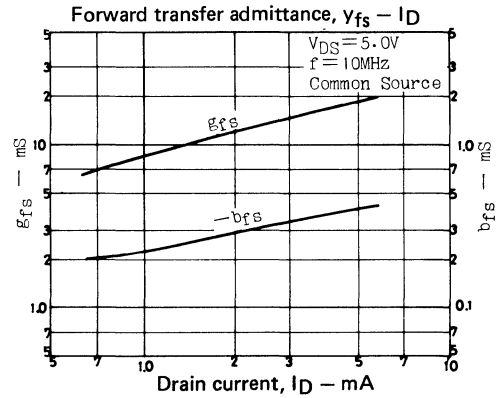
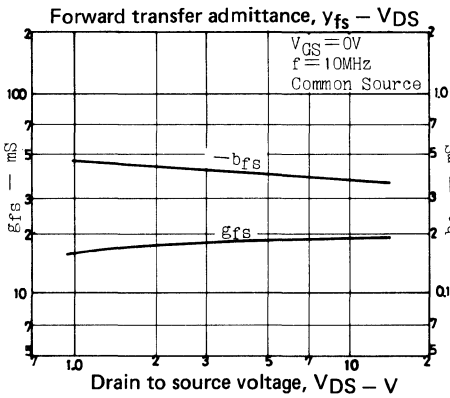
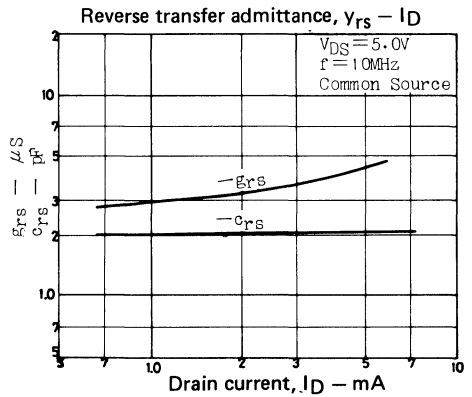
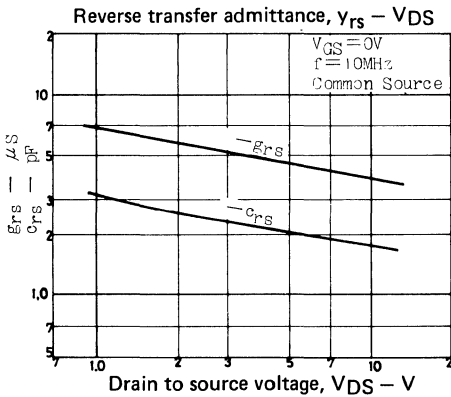
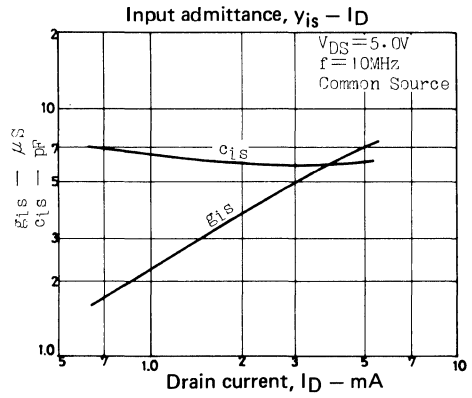
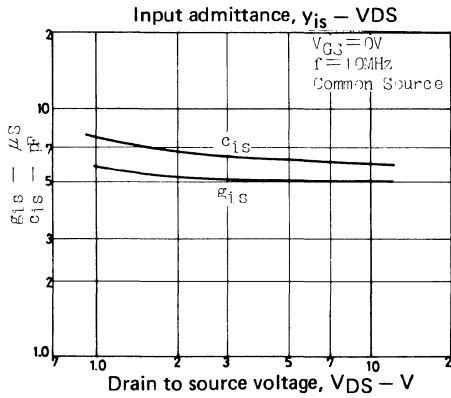
1.2	A17	2.1	1.7	A18	3.0	2.5	A19	4.2
3.5	A20	6.0	5.0	A21	8.5	7.3	A22	12.0

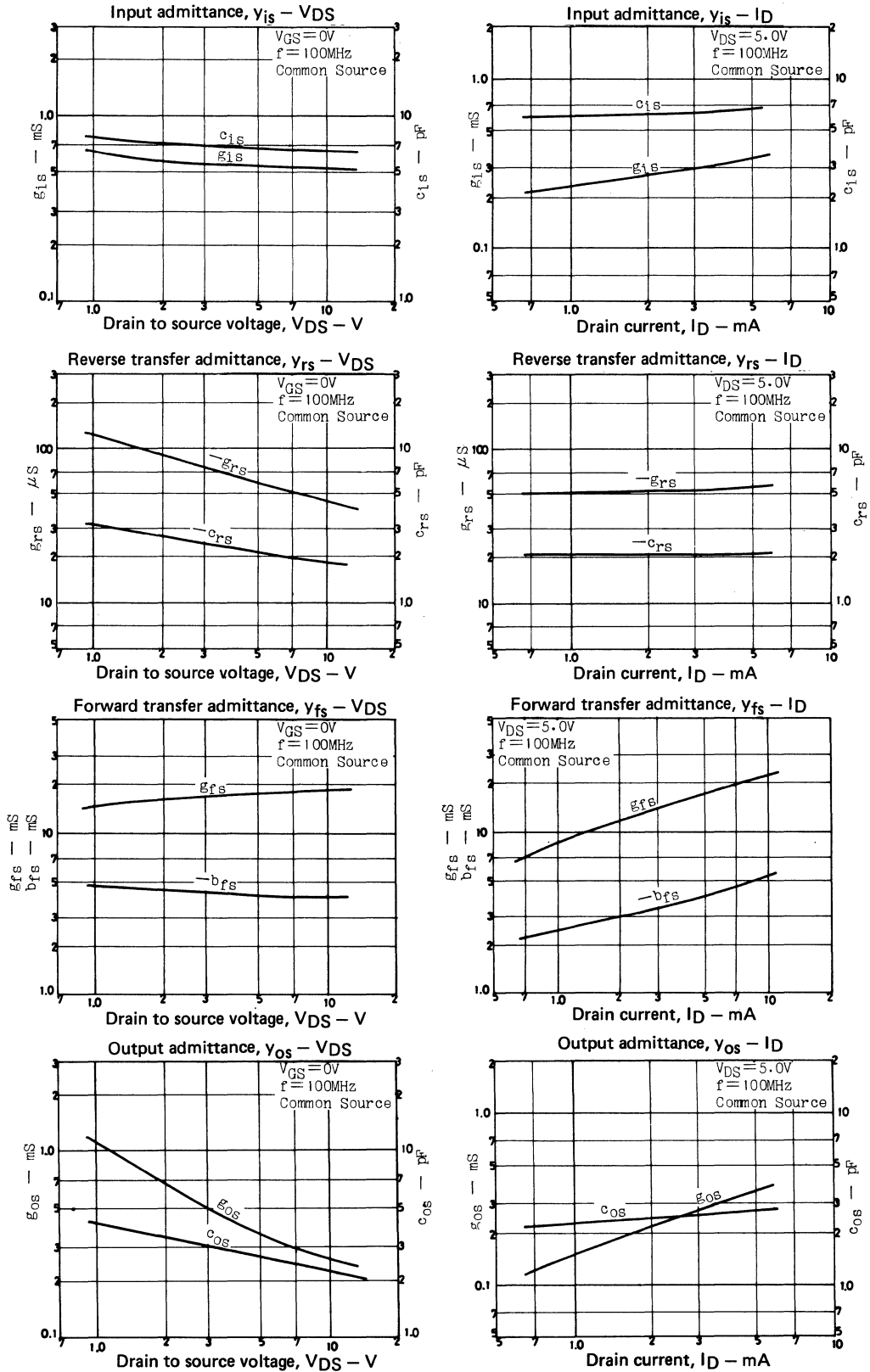
Case Outline 2021
(unit: mm)

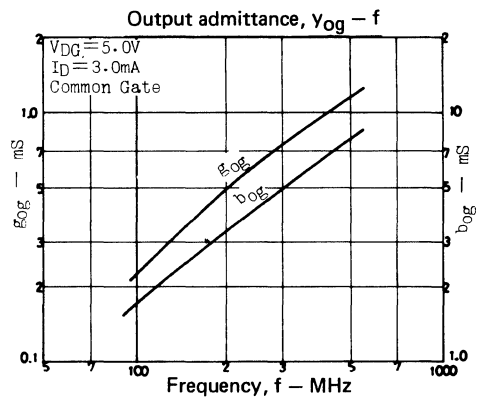
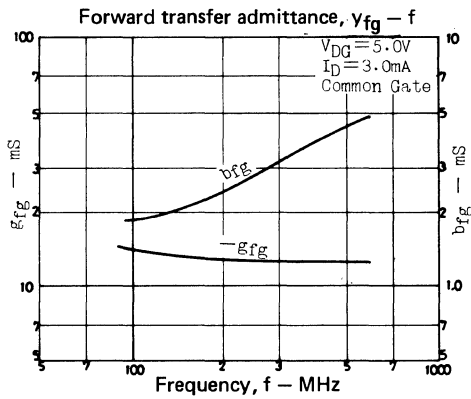
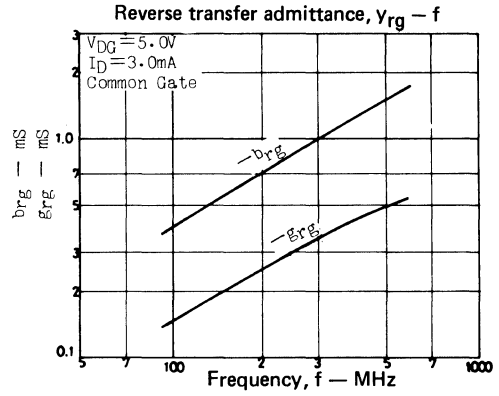
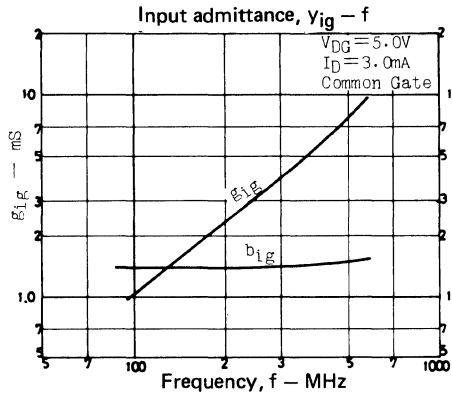












2SK443

2021

N-Channel Junction
Silicon Field-Effect Transistor

Video Camera Applications

©1419

Features

- Large $|y_{fs}|$
- Small C_{iss}
- Very-low noise figure
- Very small-sized package permitting sets to be small-sized

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Drain to source voltage	V_{DS}	15	V
Gate to drain voltage	V_{GDS}	-15	V
Gate current	I_G	10	mA
Drain current	I_D	50	mA
Power dissipation	P_D	200	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ~ +125	$^\circ\text{C}$

Electrical Characteristics/ $T_a = 25^\circ\text{C}$

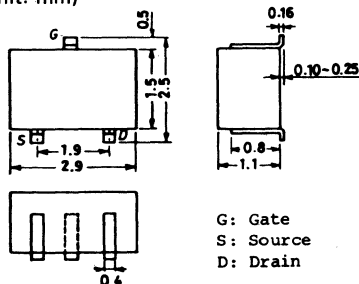
			min	typ	max	unit
Gate to drain breakdown voltage	$V_{(BR)GDS}$	$I_G = -10\mu\text{A}, V_{DS} = 0\text{V}$	-15			V
Common source gate cutoff current	I_{GSS}	$V_{GS} = -10\text{V}, V_{DS} = 0\text{V}$			-1.0	nA
Gate to source cutoff voltage	$V_{GS(off)}$	$V_{DS} = 5\text{V}, I_D = 100\mu\text{A}$		-0.9	-2.0	V
Drain current (gate-source shorted)	I_{DSS}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}$	5.0*		38.0*	mA
Forward transfer admittance	$ y_{fs} $	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{kHz}$	20	30		mS
Input capacitance	C_{iss}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		9.0		pF
Feedback capacitance	C_{rss}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		2.8		pF
Noise figure	NF	$V_{DS} = 5\text{V}, R_g = 1\text{k}\Omega, I_D = 1\text{mA}, f = 1\text{kHz}$		1.5		dB

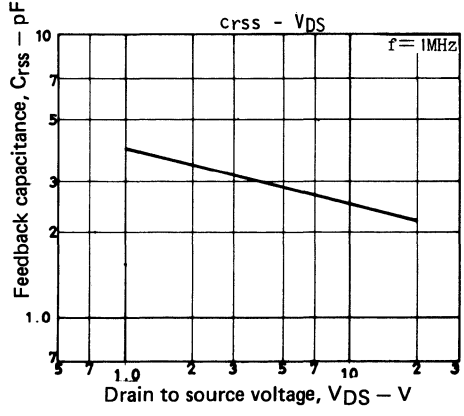
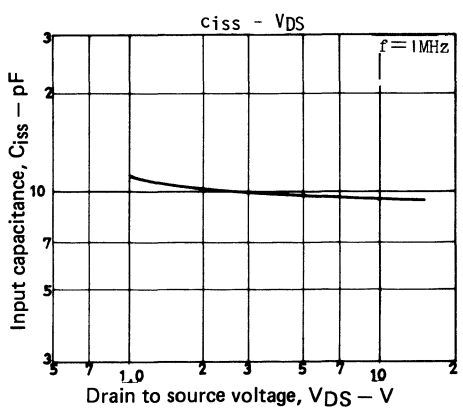
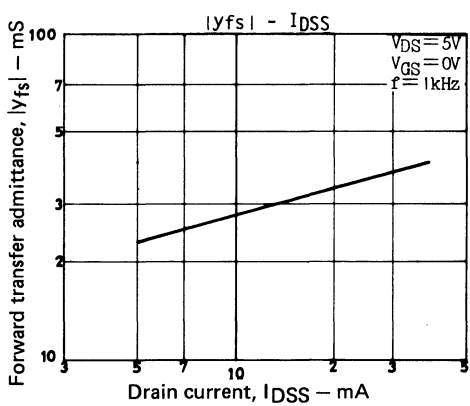
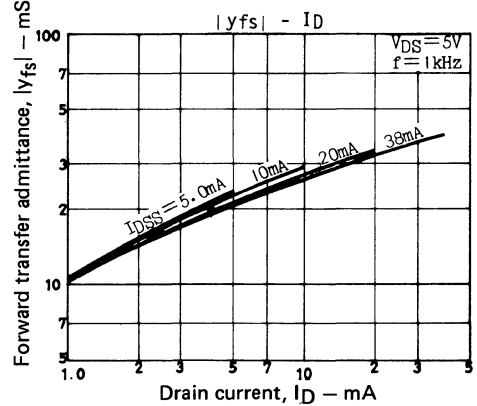
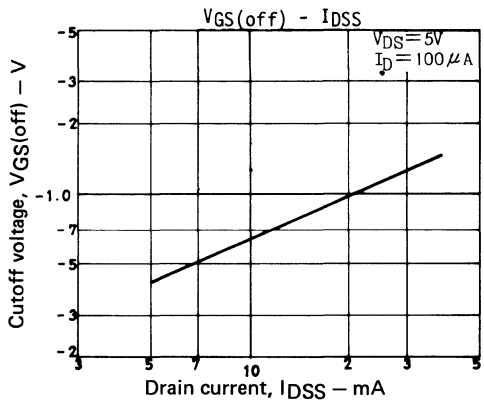
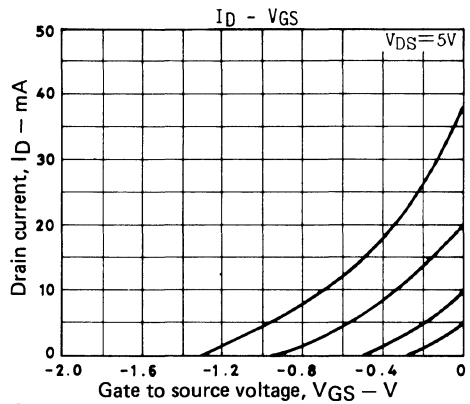
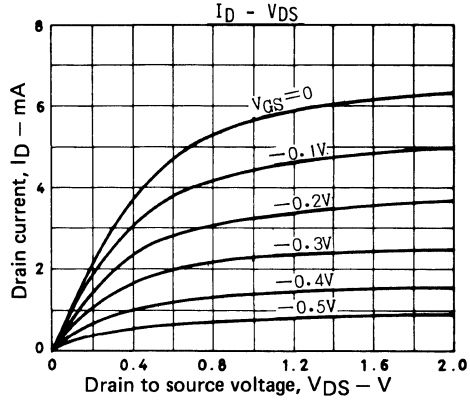
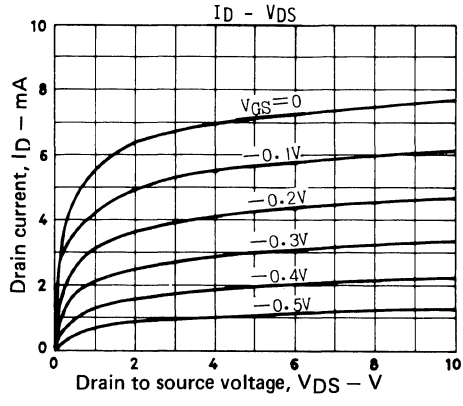
*:The 2SK443 is classified by $V_{DS} = 5\text{V}$ as follows:

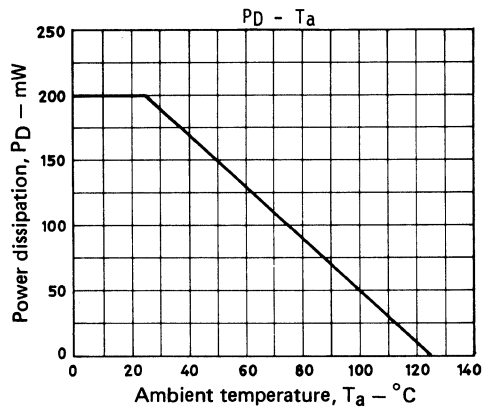
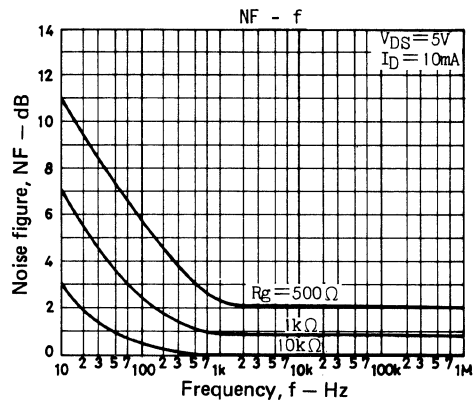
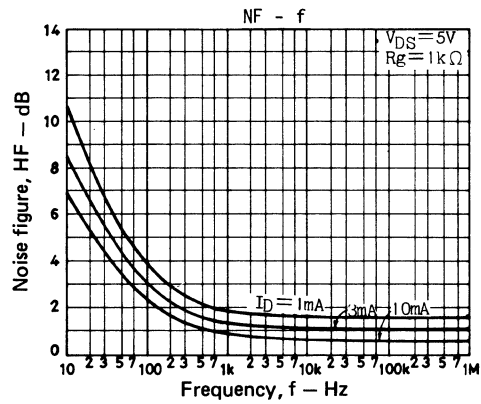
5.0	AJ5	12.0	10.0	AJ6	24.0	16.0	AJ7	38.0
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Case Outline 2021

(unit: mm)







2SK444



2034

N-Channel Junction
Silicon Field-Effect Transistor

Video Camera Applications

©1420

Features

- Large $|y_{fs}|$
- Small C_{iss}
- Very low noise figure
- High frequency, low noise amp

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

Drain to source voltage	V_{DSS}	15	unit
Gate to drain voltage	V_{GDS}	-15	V
Gate current	I_G	10	mA
Drain current	I_D	50	mA
Power dissipation	P_D	200	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ~ +125	$^\circ\text{C}$

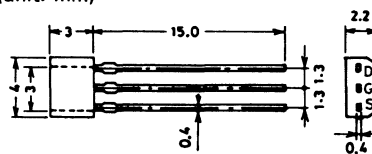
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Gate to drain breakdown voltage	$V_{(BR)GDS}$	$I_G = -10\mu\text{A}, V_{DS} = 0\text{V}$	-15			V
Common source gate cutoff current	I_{GSS}	$V_{GS} = -10\text{V}, V_{DS} = 0\text{V}$			-1.0	nA
Gate to source cutoff voltage	$V_{GS(off)}$	$V_{DS} = 5\text{V}, I_D = 100\mu\text{A}$		-0.9	-2.0	V
Drain current (gate-source shorted)	I_{DSS}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}$	5.0*		38.0*	mA
Forward transfer admittance	$ y_{fs} $	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{kHz}$	20	30		mS
Input capacitance	C_{iss}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		9.0		pF
Feedback capacitance	C_{rss}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		2.8		pF
Noise figure	NF	$V_{DS} = 5\text{V}, R_g = 1\text{k}\Omega, I_D = 1\text{mA}, f = 1\text{kHz}$		1.5		dB

*:The 2SK444 is classified by $V_{DS} = 5\text{V}$ as follows:

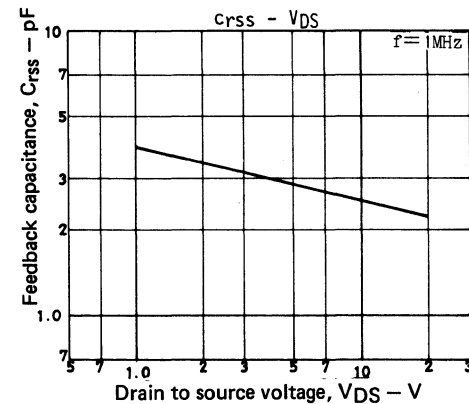
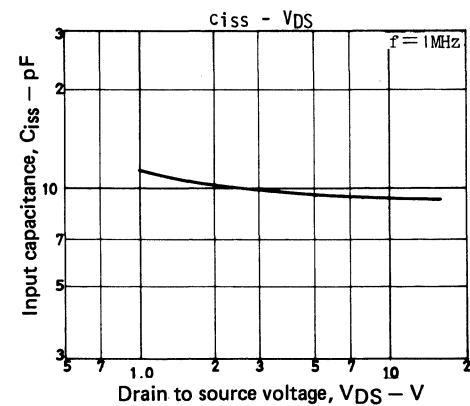
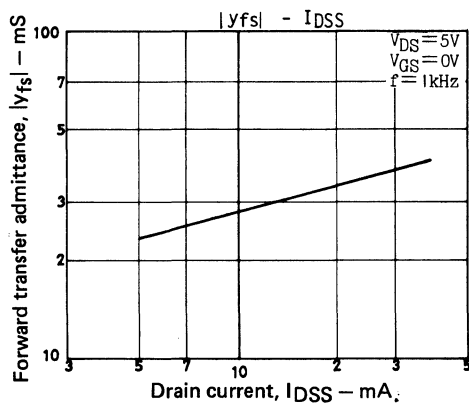
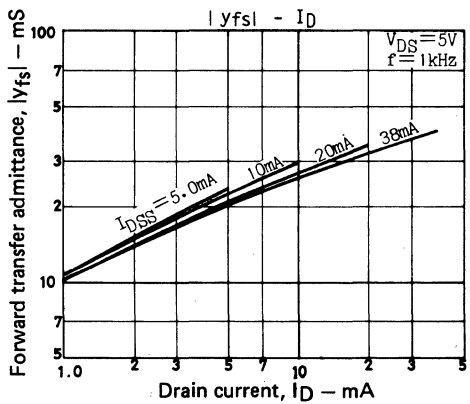
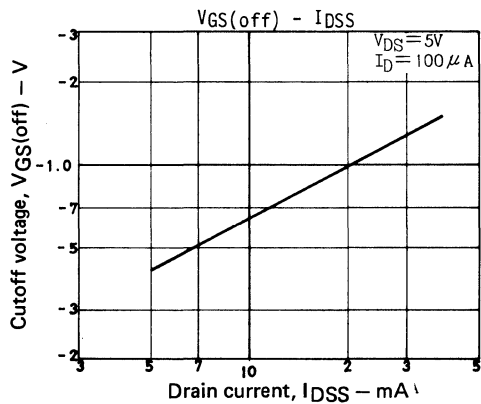
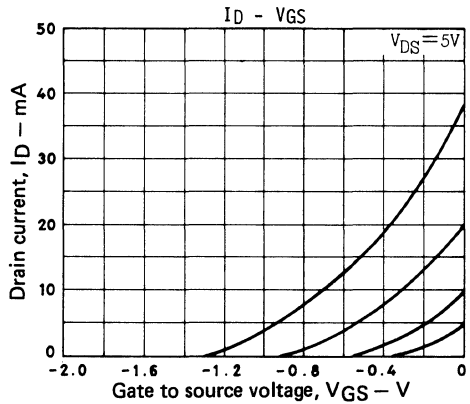
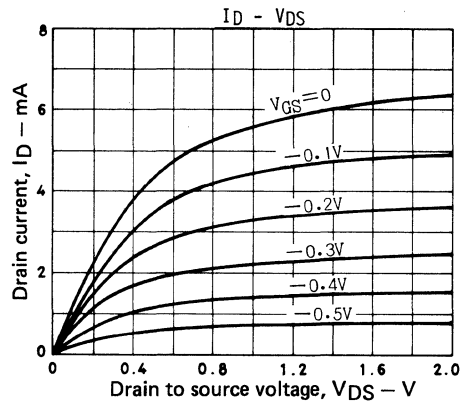
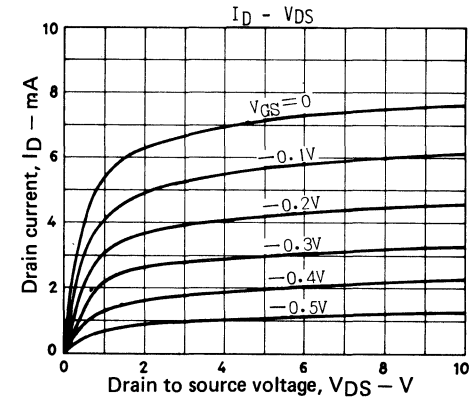
5.0	F	12.0	10.0	G	24.0	16.0	H	38.0
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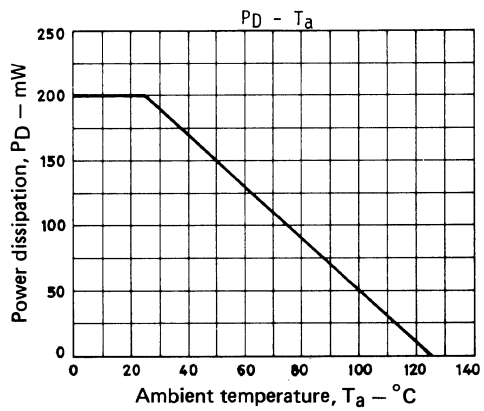
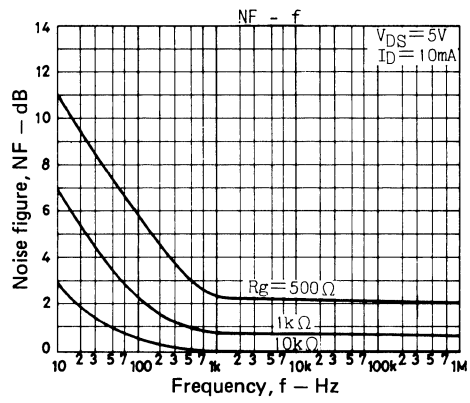
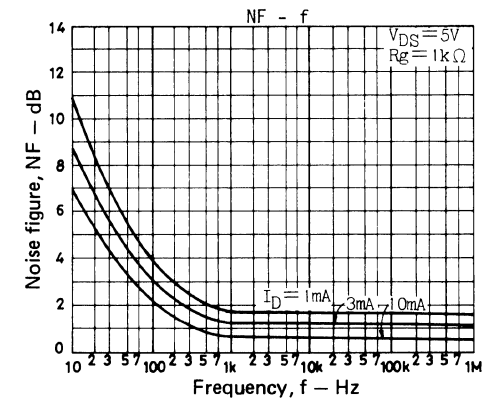
Case Outline 2034 (unit: mm)



D: Drain
G: Gate
S: Source

SANYO: SPA





2SK445



2005A

N-Channel Junction
Silicon Field-Effect Transistor

Video Camera Applications

©1439A

Features

- Large $|y_{fs}|$
- Small C_{iss}
- Very low noise figure
- High frequency, audio frequency, low noise amp

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Drain to source voltage	V_{DS}	15	V
Gate to drain voltage	V_{GDS}	-15	V
Gate current	I_G	10	mA
Drain current	I_D	50	mA
Power dissipation	P_D	300	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ~ +125	$^\circ\text{C}$

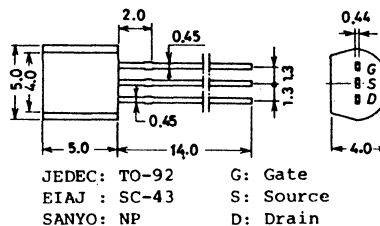
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

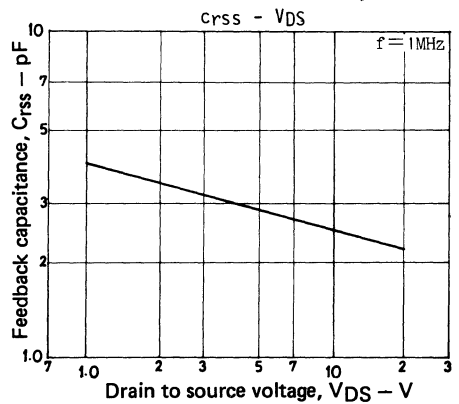
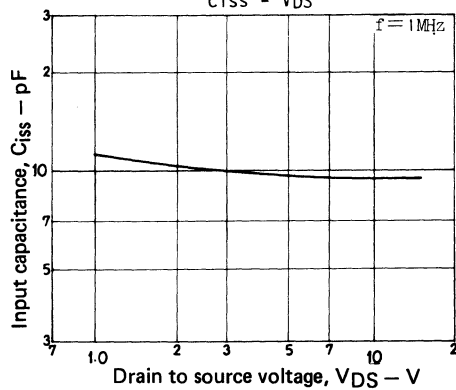
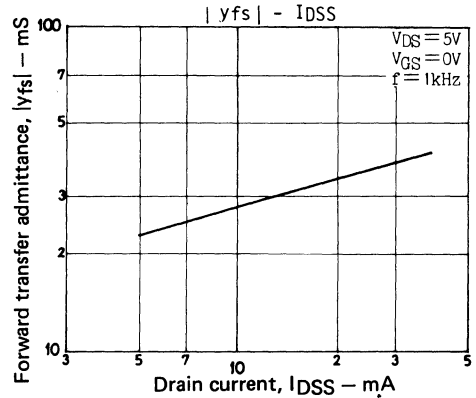
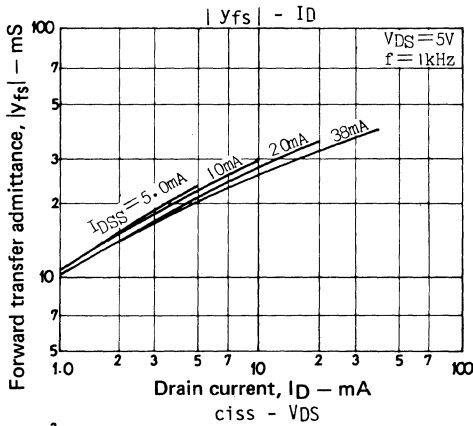
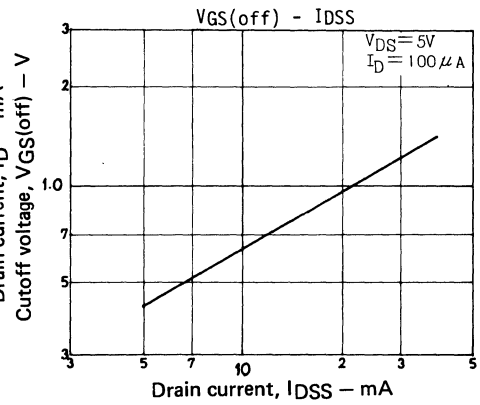
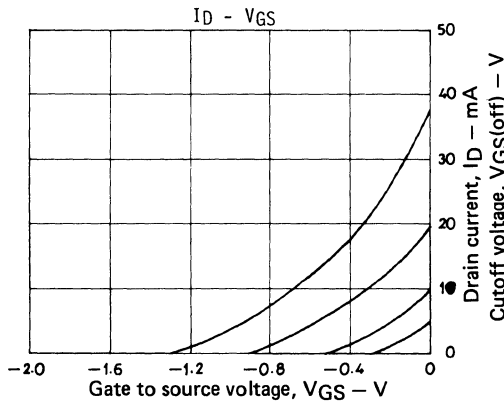
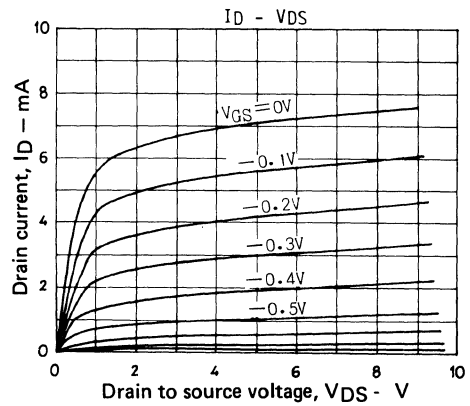
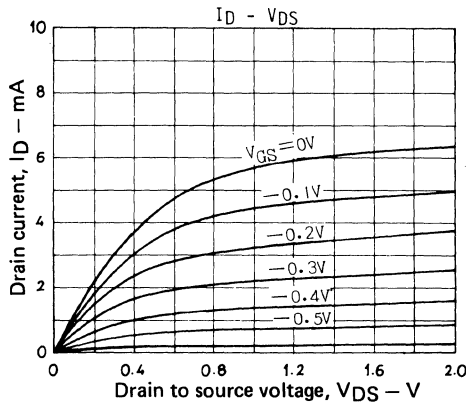
			min	typ	max	unit
Gate to drain breakdown voltage	$V_{(BR)GDS}$	$I_G = -10\mu\text{A}, V_{DS} = 0\text{V}$	-15			V
Common source gate cutoff current	I_{GSS}	$V_{GS} = -10\text{V}, V_{DS} = 0\text{V}$			-1.0	nA
Gate to source cutoff voltage	$V_{GS(off)}$	$V_{DS} = 5\text{V}, I_D = 100\mu\text{A}$		-0.9	-2.0	V
Drain current (gate-source shorted)	I_{DSS}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}$	5.0*		38.0*	mA
Forward transfer admittance	$ y_{fs} $	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{kHz}$	20	30		mS
Input capacitance	C_{iss}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		9.0		pF
Feedback capacitance	C_{rss}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		2.8		pF
Noise figure	NF	$V_{DS} = 5\text{V}, R_g = 1\text{k}\Omega, I_D = 1\text{mA}, f = 1\text{kHz}$		1.5		dB

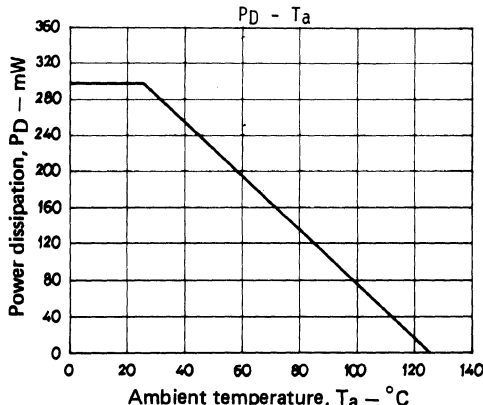
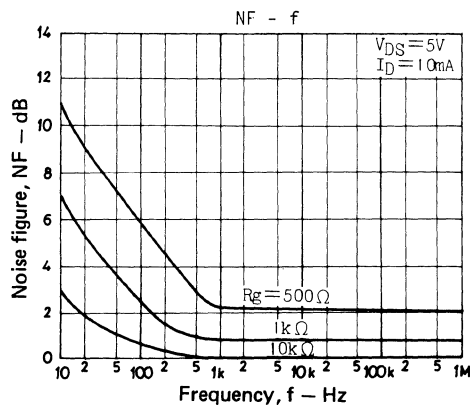
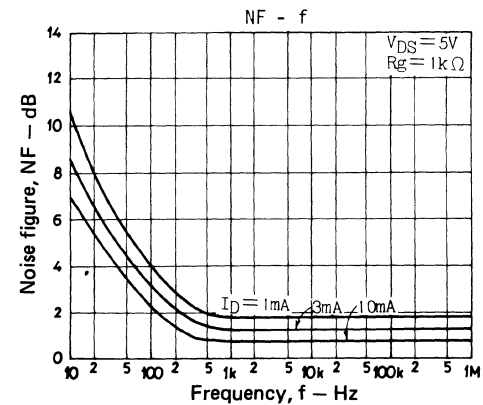
*:The 2SK445 is classified by $V_{DS} = 5\text{V}$ as follows:

5.0	F	12.0	10.0	G	24.0	16.0	H	38.0
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Case Outline 2005A (unit:mm)







2SK493



2005A

N-Channel Junction
Silicon Field-Effect Transistor

Video Camera Applications

©1406

Use

- Video Camera

Features

- Large $|y_{fs}|$
- Very low noise figure
- Small Ciss

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Drain to source voltage	V_{DS}	15	V
Gate to drain voltage	V_{GDS}	-15	V
Gate current	I_G	10	mA
Drain current	I_D	50	mA
Power dissipation	P_D	300	mW
Junction temperature	T_j	125	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 ~ +125	$^\circ\text{C}$

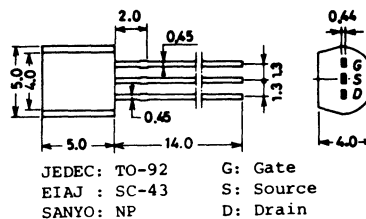
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

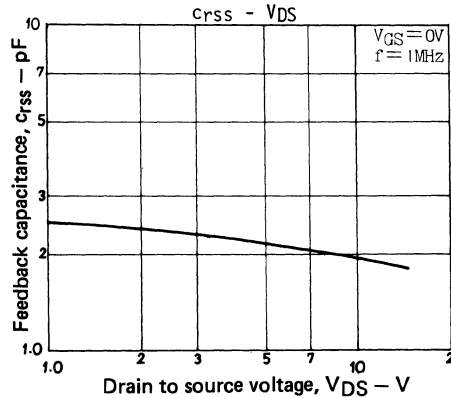
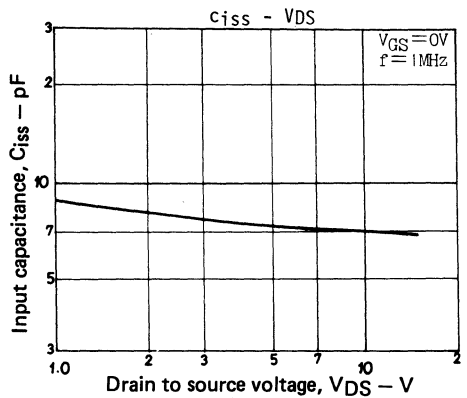
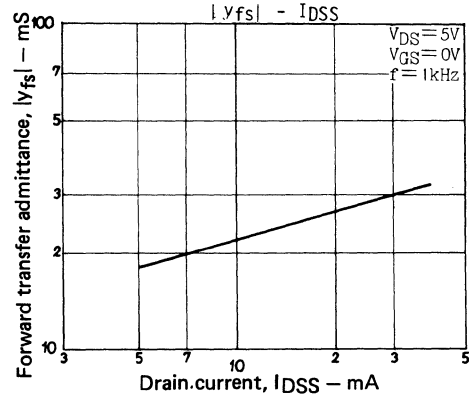
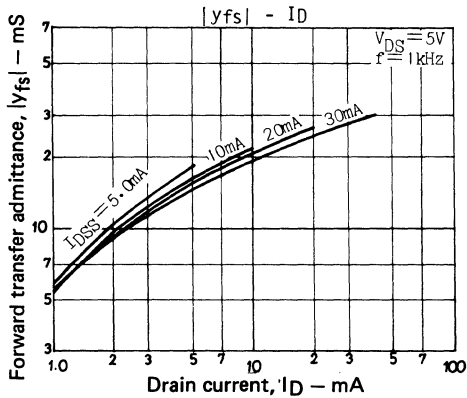
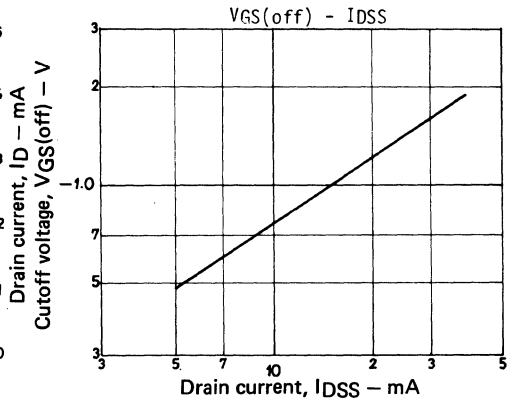
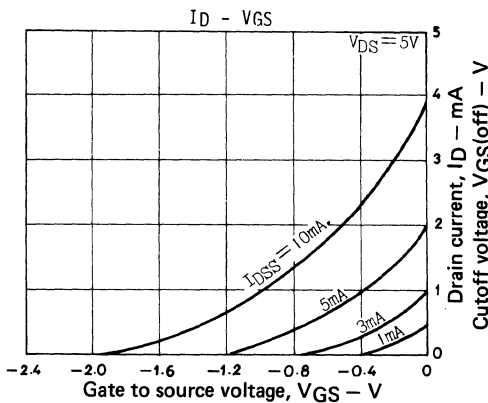
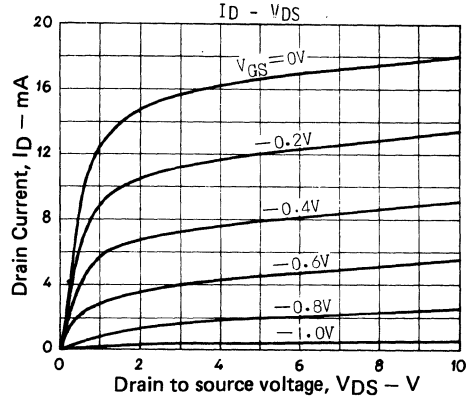
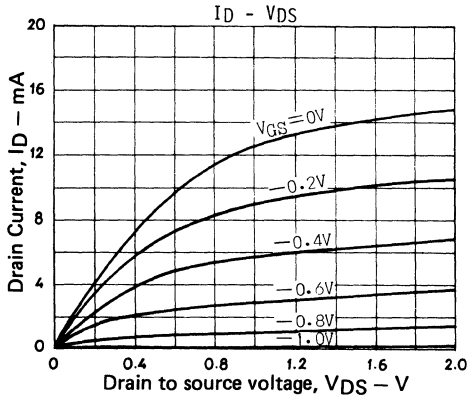
			min	typ	max	unit
Gate to drain breakdown voltage	$V_{(BR)GDS}$	$I_G = -10\mu\text{A}, V_{DS} = 0\text{V}$	-15			V
Common source gate cutoff current	I_{GSS}	$V_{GS} = -10\text{V}, V_{DS} = 0\text{V}$			-1.0	nA
Gate to source cutoff voltage	$V_{GS(off)}$	$V_{DS} = 5\text{V}, I_D = 100\mu\text{A}$		-0.8	-2.2	V
Drain current (gate-source shorted)	I_{DSS}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}$	5.0*		38.0*	mA
Forward transfer admittance	$ y_{fs} $	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{kHz}$	15	27		mS
Input capacitance	C_{iss}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		7.0		pF
Feedback capacitance	C_{rss}	$V_{DS} = 5\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		2.0		pF
Noise figure	NF	$V_{DS} = 5\text{V}, R_g = 1\text{k}\Omega, I_D = 1\text{mA}, f = 1\text{kHz}$		1.5		dB

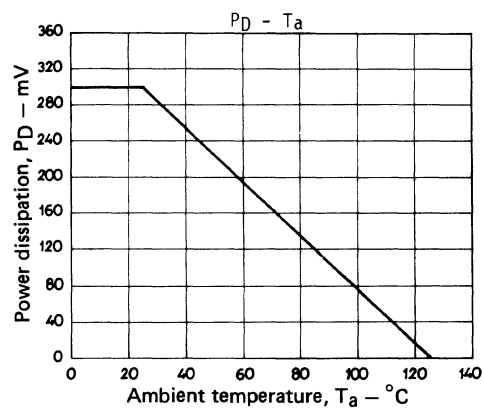
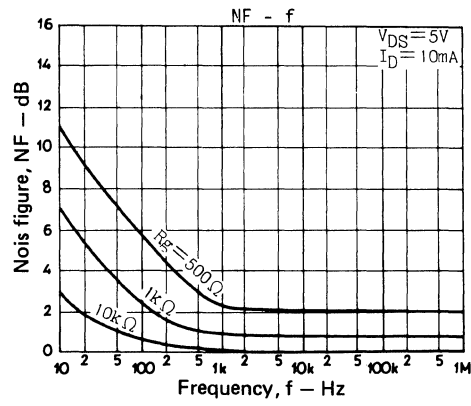
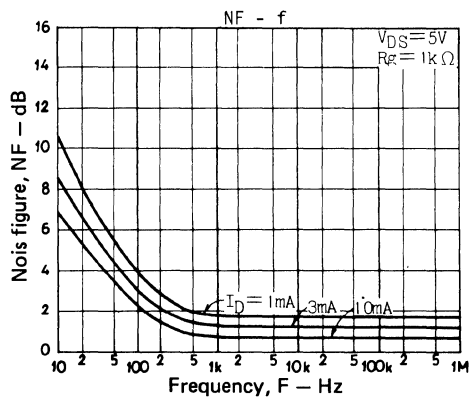
*:The 2SK493 is classified by I_{DSS} as follows:

5.0	F	12.0	10.0	G	24.0	16.0	H	38.0
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Case Outline 2005A (unit: mm)









2024

N-Channel MOS
Silicon Field-Effect Transistor

FM Tuner, VHF Band Amp Applications

©1791

Features

- Low noise. $NF = 1.8\text{dB}$ typ ($f = 100\text{MHz}$)
- High power gain. $PG = 27\text{dB}$ typ ($f = 100\text{MHz}$)
- Small reverse transfer capacitance. $c_{rss} = 0.035\text{pF}$ ($V_{DS} = 10\text{V}$, $f = 1\text{MHz}$)

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

			unit
Drain to source voltage	V_{DS}	20	V
Gate to source voltage	V_{GS}	± 5	V
Drain current	I_D	20	mA
Allowable power dissipation	P_D	200	mW
Channel temperature	T_{ch}	125	$^\circ\text{C}$
Storage temperature	T_{stg}	-55 to $+125$	$^\circ\text{C}$

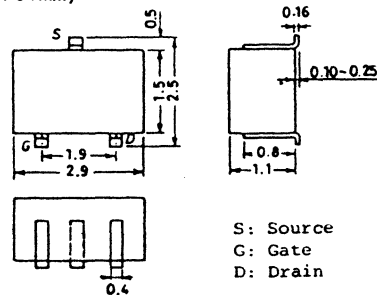
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

			min	typ	max	unit
Drain to source voltage	V_{DSX}	$V_{GS} = -4\text{V}$, $I_D = 100\mu\text{A}$	20			V
Common source gate cutoff current	I_{GSS}	$V_{DS} = 0\text{V}$, $V_{GS} = \pm 5\text{V}$			10	nA
Drain current	I_{DSS}	$V_{DS} = 10\text{V}$, $V_{GS} = 0$	1.2		12	mA
Gate to source cutoff voltage	$V_{GS}(\text{off})$	$V_{DS} = 10\text{V}$, $I_D = 100\mu\text{A}$			25	V
Forward transfer admittance	$ Y_{fs} $	$V_{DS} = 10\text{V}$, $V_{GS} = 0$, $f = 1\text{kHz}$		11		mS
Input capacitance	c_{iss}	$V_{DS} = 10\text{V}$, $V_{GS} = 0$, $f = 1\text{MHz}$		2.4		pF
Reverse transfer capacitance	c_{rss}			0.035		pF
Power gain	PG	$V_{DS} = 10\text{V}$, $V_{GS} = 0$, $f = 100\text{MHz}$		27		dB
Noise figure	NF			1.8	3.0	dB

*: The 2SK543 is classified by I_{DSS} as follows (unit: mA):

1.2	D	3.0	2.5	E	6.0	5.0	F	12
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Case Outline 2024 (unit:mm)



2SK544



2040

N-Channel MOS
Silicon Field-Effect Transistor

FM Tuner, VHF Band Amp Applications

©1792

Features

- Low noise. $NF = 1.8\text{dB typ}$ ($f = 100\text{MHz}$)
- High power gain. $P_G = 27\text{dB typ}$ ($f = 100\text{MHz}$)
- Small reverse transfer capacitance. $c_{rss} = 0.035\text{pF}$ ($V_{DS} = 10\text{V}$, $f = 1\text{MHz}$)

Absolute Maximum Ratings/ $T_a = 25^\circ\text{C}$

Drain to source voltage	V_{DS}	20	V
Gate to source voltage	V_{GS}	± 5	V
Drain current	I_D	20	mA
Allowable power dissipation	P_D	300	mW
Channel temperature	T_{ch}	125	$^{\circ}\text{C}$
Storage temperature	T_{stq}	-55 to +125 $^{\circ}\text{C}$	

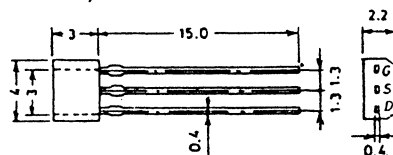
Electrical Characteristics/ $T_a = 25^\circ\text{C}$

		min	typ	max	unit
Drain to source voltage	V_{DSX}	20			V
Common source gate cutoff current	I_{GSS}			10	nA
Drain current	I_{DSS}	1.2		12	mA
Gate to source cutoff voltage	$V_{GS} \text{ (off)}$			-2.5	V
Forward transfer admittance	$ Y_{fs} $		11		mS
Input capacitance	c_{iss}		2.4		pF
Reverse transfer capacitance	c_{rss}		0.035		pF
Power gain	P_G		27		dB
Noise figure	NF		1.8	3.0	dB

* The 2SK543 is classified by I_{DSS} as follows (unit: mm):

1.2	D	3.0	2.5	E	6.0	5.0	F	12
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Case Outline 2040 (unit:mm)



G: Gate
S: Source
D: Drain

SANYO: SPA

2SK545

2021

N-Channel Junction
Silicon Field-Effect Transistor

Impedance Conversion Applications

©1789

Applications

- Impedance conversion
- Infrared sensor

Features

- Low I_{GSS}
- Small c_{iss}
- Very small package permitting 2SK545-used sets to be made smaller and slimmer

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$

			unit
Drain to Source Voltage	V_{DS}	40	V
Gate to Drain Voltage	V_{GDS}	-40	V
Gate Current	I_G	10	mA
Drain Current	I_D	1	mA
Allowable Power Dissipation	P_D	100	mW
Junction Temperature	T_j	125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +125	$^\circ\text{C}$

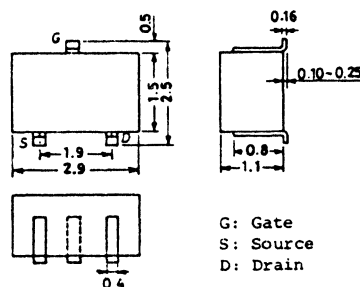
Electrical Characteristics at $T_a=25^\circ\text{C}$

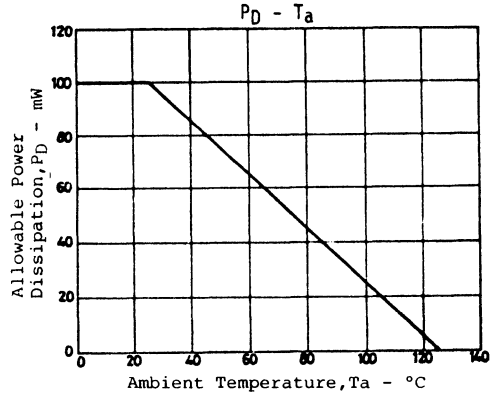
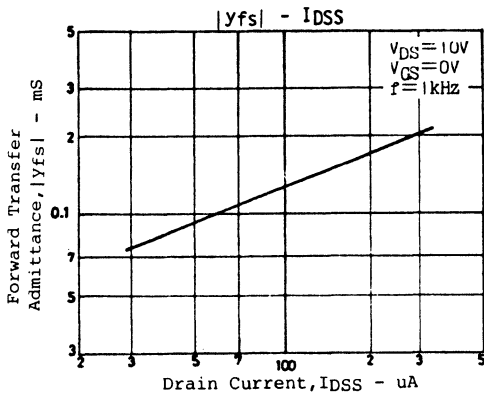
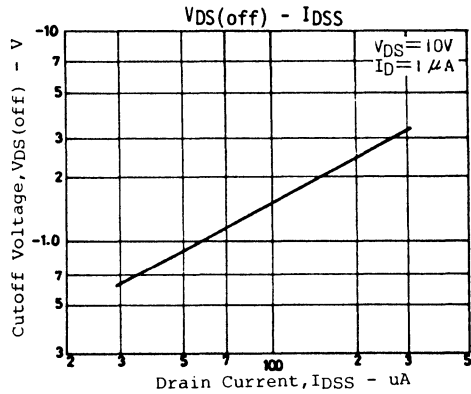
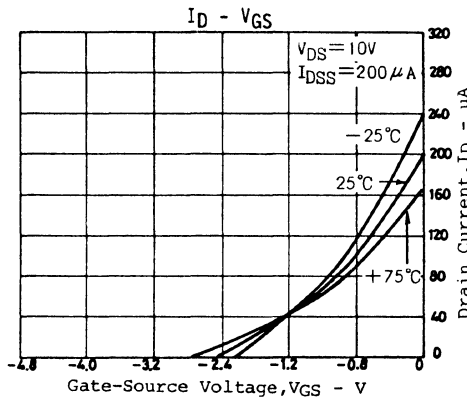
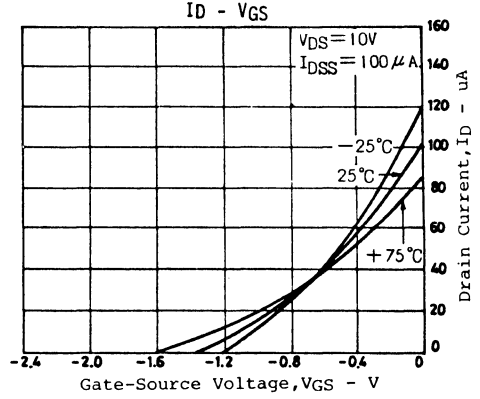
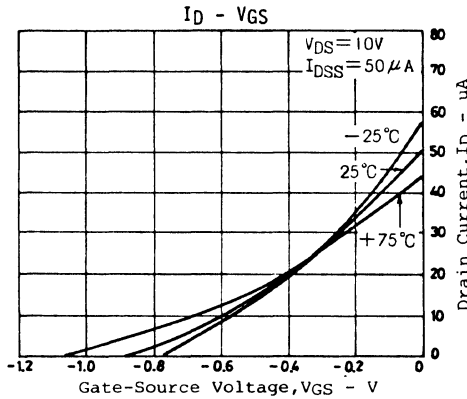
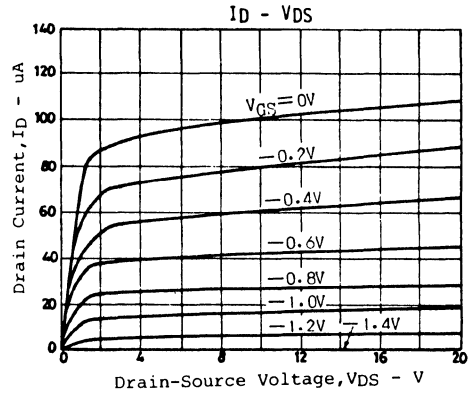
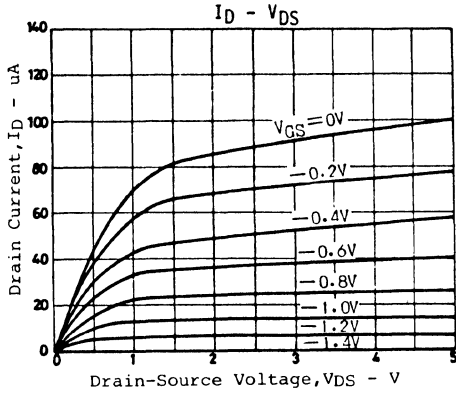
			min	typ	max	unit
Gate to Drain Breakdown Voltage	$V(BR)_{GDS}$	$I_G=-10\mu\text{A}, V_{DS}=0$	-40			V
Gate Cutoff Current	I_{GSS}	$V_{GS}=-20\text{V}, V_{DS}=0$			-500	pA
Cutoff Current	$V_{GS}(\text{off})$	$V_{DS}=10\text{V}, I_D=1\mu\text{A}$		-1.5	-4.0	V
Drain Current	I_{DSS}	$V_{DS}=10\text{V}, V_{GS}=0$	30*		300*	μA
Forward Transfer Admittance	$ y_{fs} $	$V_{DS}=10\text{V}, V_{GS}=0, f=1\text{kHz}$	0.05	0.13		mS
Input Capacitance	c_{iss}	$V_{DS}=10\text{V}, V_{GS}=0, f=1\text{MHz}$		1.7		pF
Reverse Transfer Capacitance	c_{rss}	$V_{DS}=10\text{V}, V_{GS}=0, f=1\text{MHz}$		0.7		pF

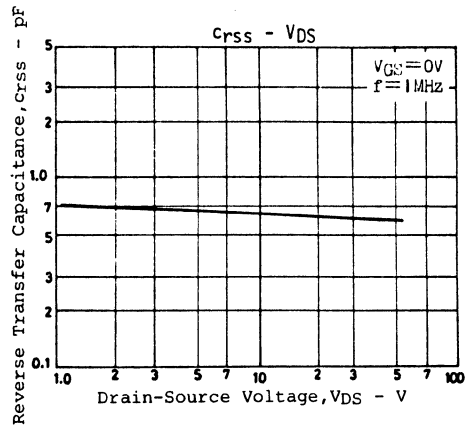
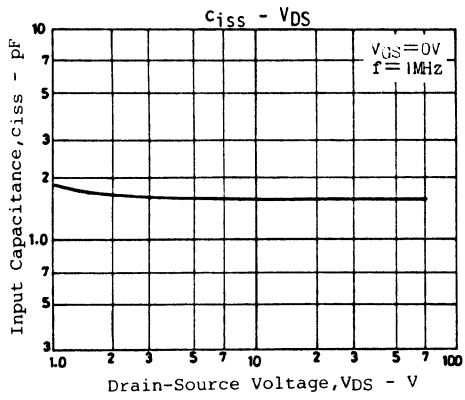
* The 2SK545 is classified by I_{DSS} as follows (unit:mm):

30	B10	80	60	B11	180	150	B12	300
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Case Outline 2021 (unit:mm)









2034

N-Channel Junction Silicon Field-Effect Transistor

Impedance Conversion Applications

Ⓔ1790

Applications

- Impedance conversion
- Infrared sensor

Features

- Low IGSS
- Small c_{iss}

Absolute Maximum Ratings at Ta=25°C

Absolute Maximum Ratings at Ta=25°C		unit
Drain to Source Voltage	V _{DSS}	40 V
Gate to Drain Voltage	V _{GDS}	-40 V
Gate Current	I _G	10 mA
Drain Current	I _D	1 mA
Allowable Power Dissipation	P _D	100 mW
Junction Temperature	T _j	125 °C
Storage Temperature	T _{stg}	-55 to +125 °C

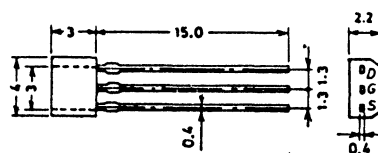
Electrical Characteristics at $T_a=25^\circ\text{C}$

Electrical Characteristics at Ta=25°C			min	typ	max	unit
Gate to Drain Breakdown Voltage	V(BR)GDS	IG=-10uA, VDS=0	-40			V
Gate Cutoff Current	IGSS	VGS=-20V, VDS=0			-500	pA
Cutoff Voltage	VGS(off)	VDS=10V, ID=1uA		-1.5	-4.0	V
Drain Current	IDSS	VDS=10V, VGS=0	30*		300*	uA
Forward Transfer Admittance	Yfs	VDS=10V, VGS=0, f=1KHz	0.05	0.13		mS
Input Capacitance	ciss	VDS=10V, VGS=0, f=1MHz		1.9		pF
Reverse Transfer Capacitance	crss	VDS=10V, VGS=0, f=1MHz		0.7		pF

* The 2SK546 is classified by IpSS as follows (unit:mm):

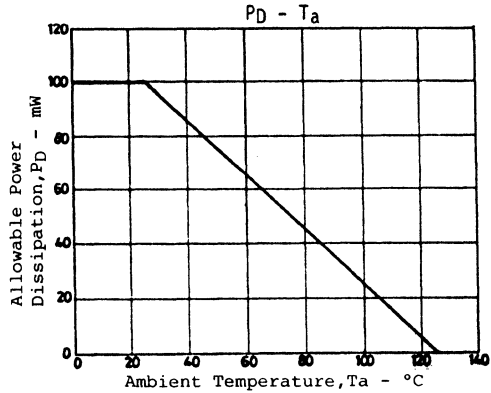
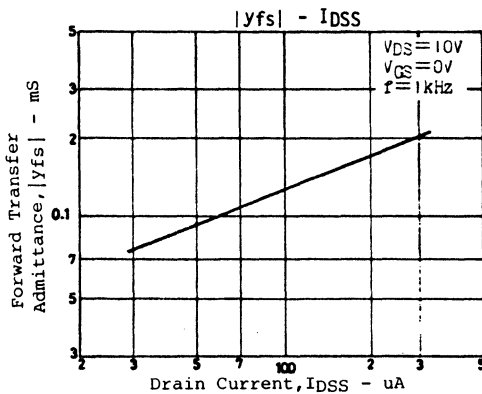
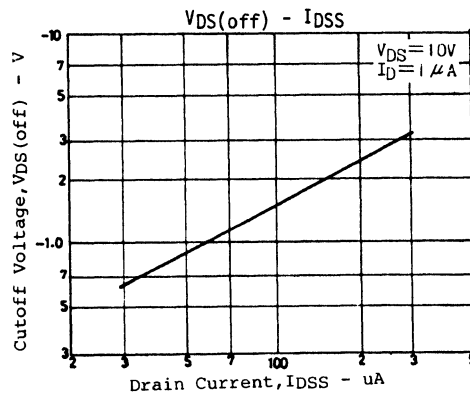
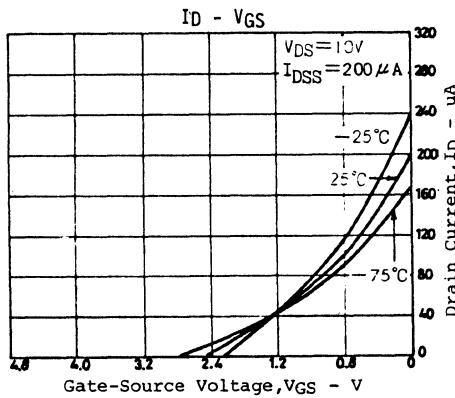
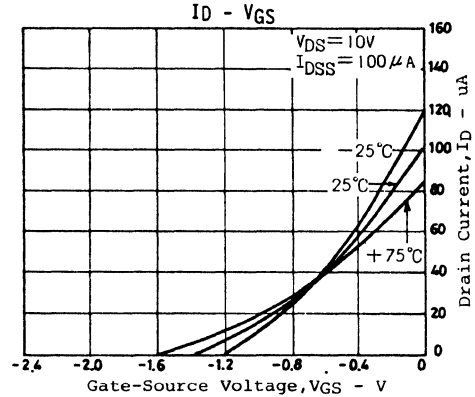
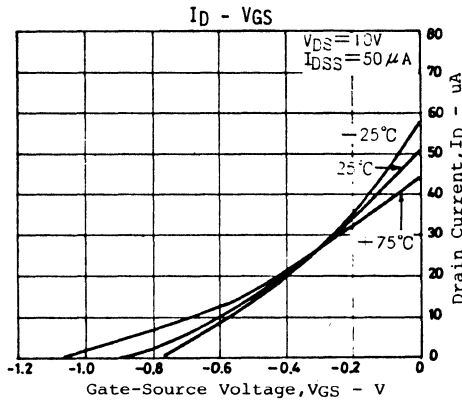
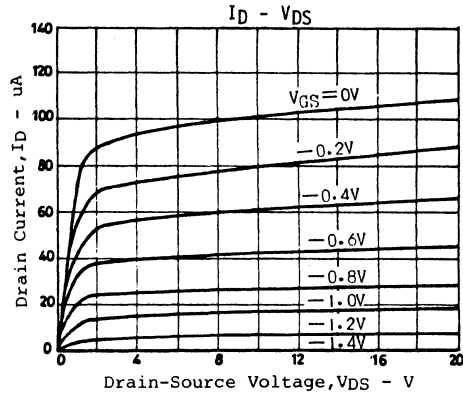
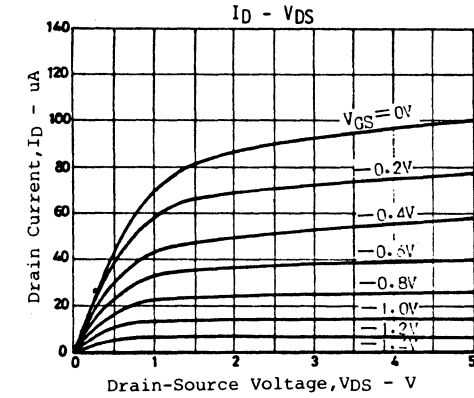
30	I	80	60	J	180	150	K	300
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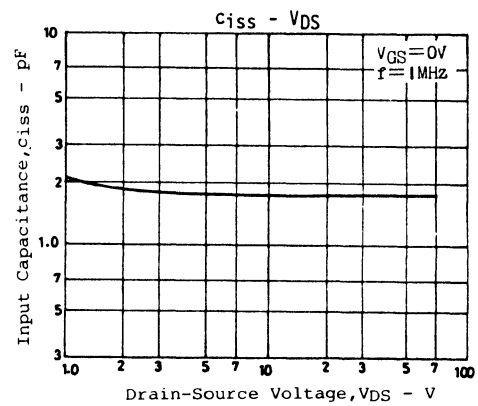
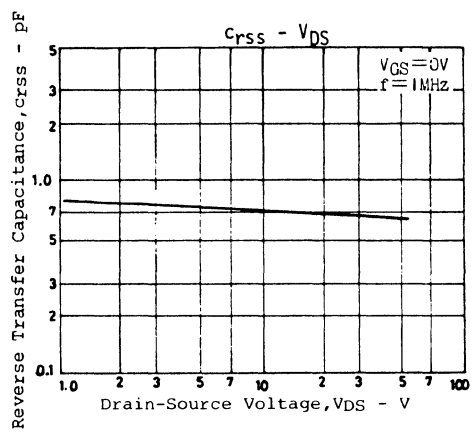
Case Outline 2034
(unit:mm)



D: Drain
G: Gate
S: Source

SANYO: SPA





2SK583



2005A

N-Channel Enhancement MOS
Silicon Field-Effect Transistor

Analog Switch Applications

©1793

Use

- . Analog switches, low-pass filters.

Features

- . Large $|y_{fs}|$.
- . Enhancement type.
- . Small ON-resistance.

Absolute Maximum Ratings at $T_a=25^{\circ}\text{C}$

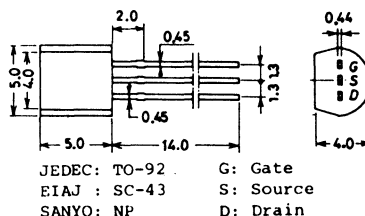
			unit
Drain to Source Voltage	V_{DS}	50	V
Gate to Source Voltage	V_{GS}	± 12	V
Drain Current	I_D	200	mA
Peak Drain Current	$I_{D \text{ peak}}$	300	mA
Device Dissipation	P_D	600	mW
Channel Temperature	T_{ch}	125	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 to +125	$^{\circ}\text{C}$

Electrical Characteristics at $T_a=25^{\circ}\text{C}$

			min	typ	max	unit
Drain to Source Voltage	$V_{(BR)DS}$	$I_D=10\mu\text{A}, V_{GS}=0\text{V}$	50			V
Gate Cutoff Current	I_{GSS}	$V_{DS}=10\text{V}, V_{GS}=0\text{V}$		0.01	10	nA
Cutoff Voltage	$V_{GS(off)}$	$V_{DS}=10\text{V}, I_D=100\mu\text{A}$	0.3	0.9	1.5	V
Drain Current	I_{DSS}	$V_{DS}=20\text{V}, V_{GS}=0\text{V}$			1	uA
Forward Transfer Admittance	$ y_{fs} $	$V_{DS}=10\text{V}, V_{GS}=50\text{mA}, f=1\text{kHz}$	25	40		ms
Input Capacitance	c_{iss}	$V_{DS}=10\text{V}, V_{GS}=0, f=1\text{MHz}$		15		pF
Output Capacitance	c_{oss}	$V_{DS}=10\text{V}, V_{GS}=0, f=1\text{MHz}$		6		pF
Reverse Transfer Capacitance	c_{rss}	$V_{DS}=10\text{V}, V_{GS}=0, f=1\text{MHz}$		0.5		pF
ON Resistance	$r_{DS(on)}$	$V_{DS}=10\text{V}, I_D=10\text{mA}$		20		ohm

Case Outline 2005A

(unit:mm)



3205MY, TS No.1793-1/1

3SK107



2031A

N-Channel MOS
Silicon Field-Effect Transistor (Dual Gate)

High Frequency, General-Purpose Amp Applications

©985B

Use:

- FM tuners and VHF tuners

Features:

- High power gain and small noise figure
- Large forward transfer admittance

Absolute Maximum Ratings at Ta=25°C

			unit
Drain-Source Voltage	V _{DS}	20	V
Gate 1-Source Voltage	V _{G1S}	±7	V
Gate 2-Source Voltage	V _{G2S}	±7	V
Drain Current	I _D	30	mA
Allowable Power Dissipation	P _D	250	mW
Channel Temperature	T _{ch}	125	°C
Storage Temperature	T _{stg}	-55 to +125	°C

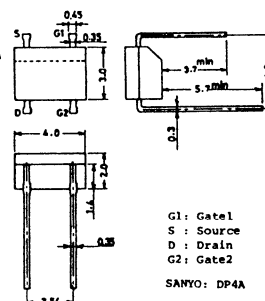
Electrical Characteristics at Ta=25°C

			min	typ	max	unit
Drain-Source Voltage	V _{DS}	V _{G1S} =-7V, V _{G2S} =0, I _D =10uA	20			V
Gate1-S Breakdown Voltage	V(BR)G1SS	I _{G1} =10uA, V _{DS} =0, V _{G2S} =0	±7			V
Gate2-S Breakdown Voltage	V(BR)G2SS	I _{G2} =10uA, V _{DS} =0, V _{G1S} =0	±7			V
Gate1-S Cutoff Voltage	V _{G1S} (off)	V _{DS} =10V, V _{G2S} =4V, I _D =100uA			-3	V
Gate2-S Cutoff Voltage	V _{G2S} (off)	V _{DS} =10V, V _{G1S} =0V, I _D =100uA			-2.5	V
Gate 1 Leak Current	I _{G1SS}	V _{G1S} =±7V, V _{DS} =0, V _{G2S} =0			±50	nA
Gate 2 Leak Current	I _{G2SS}	V _{G2S} =±7V, V _{DS} =0, V _{G1S} =0			±50	nA
Drain Current	I _{DSS}	V _{DS} =10V, V _{G1S} =0, V _{G2S} =4V	2.5		24	mA
Forward transfer Admittance	y _{fs}	V _{DS} =10V, V _{G2S} =4V, I _D =10mA		17		mS
		f=1KHz				
Reverse Transfer Capacitance	C _{rss}	V _{DS} =10V, V _{G2S} =4V, V _{G1S} =0		0.02	0.05	pF
		f=1MHz				
Input Capacitance	C _{iss}	V _{DS} =10V, V _{G2S} =4V, V _{G1S} =0		5.5		pF
		f=1MHz				
Output Capacitance	C _{oss}	V _{DS} =10V, V _{G2S} =4V, V _{G1S} =0		4.6		pF
		f=1MHz				
Power Gain	P _G	V _{DS} =10V, V _{G2S} =4V, I _D =10mA	20	26		dB
		f=100MHz				
Noise Figure	NF	V _{DS} =10V, I _D =10mA, V _{G2S} =4V		2.2	3.5	dB
		f=100MHz				

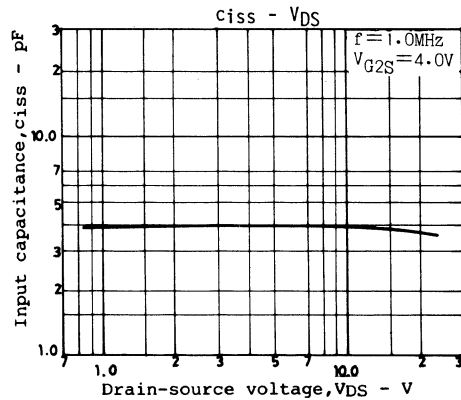
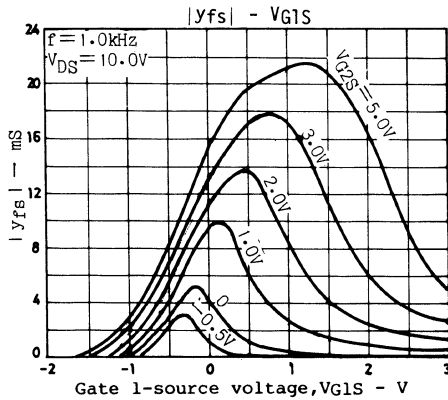
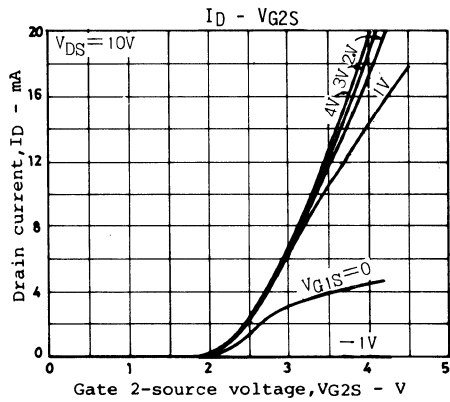
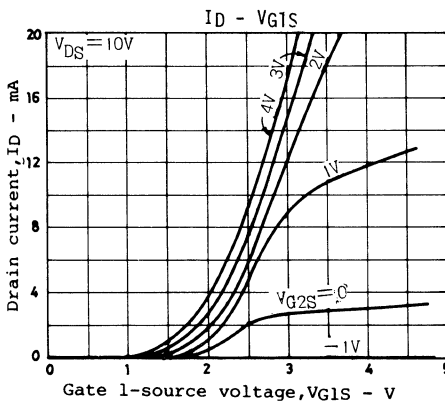
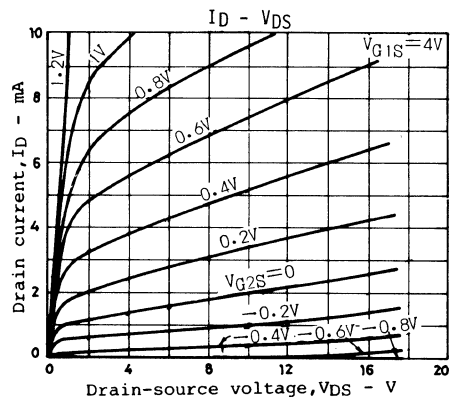
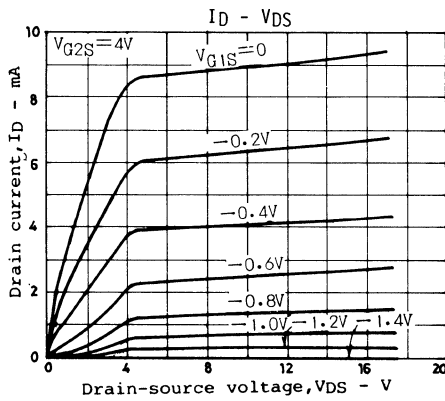
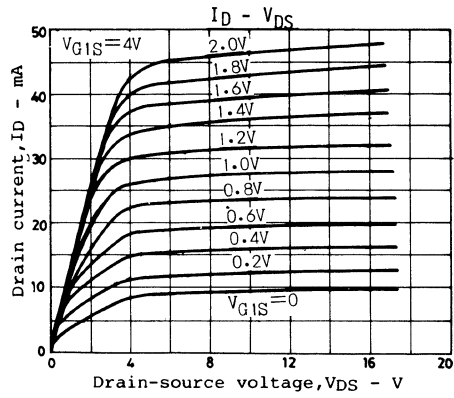
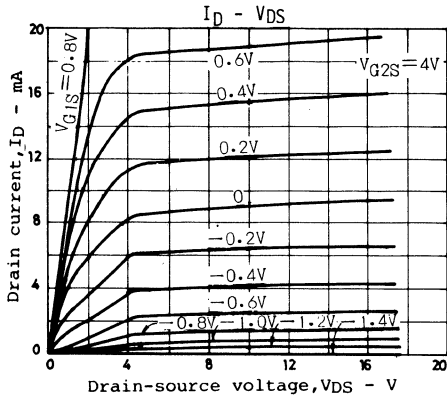
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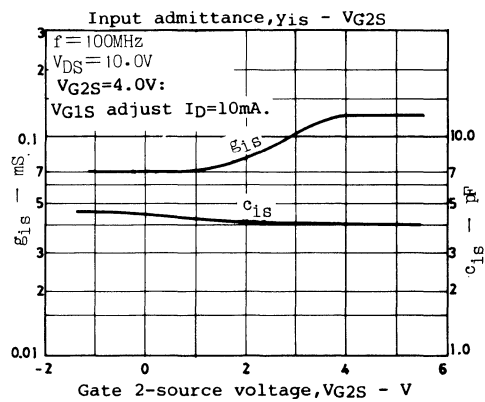
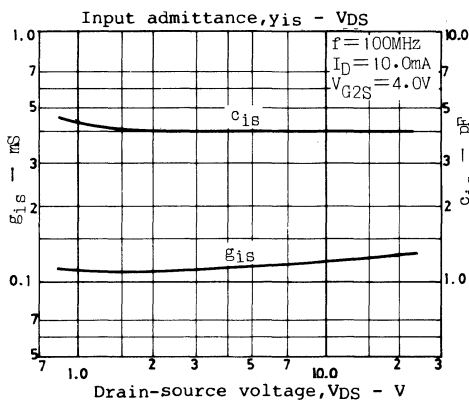
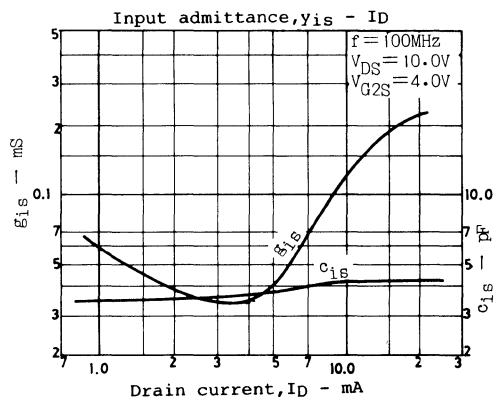
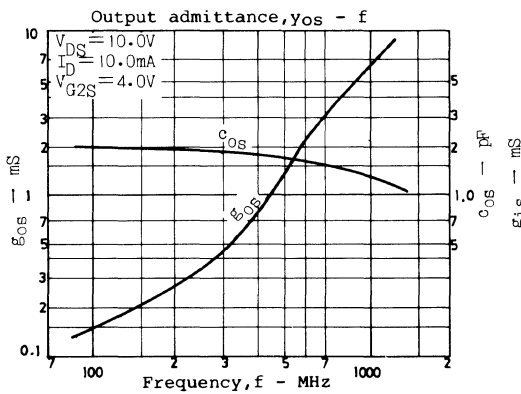
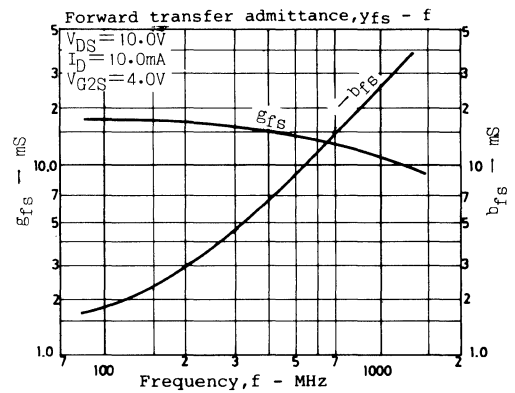
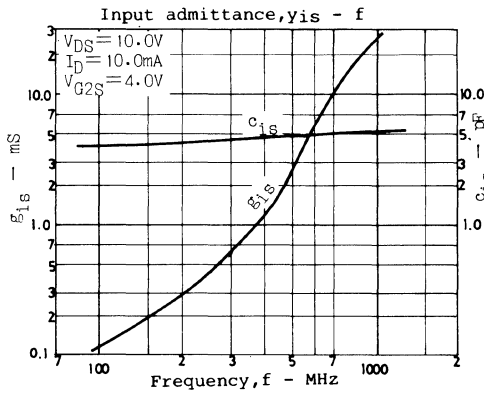
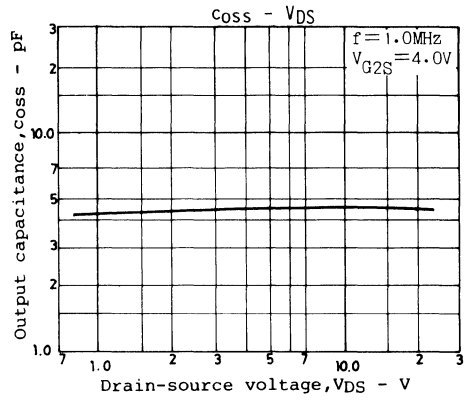
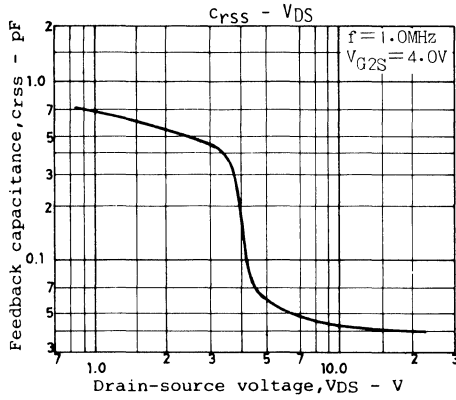
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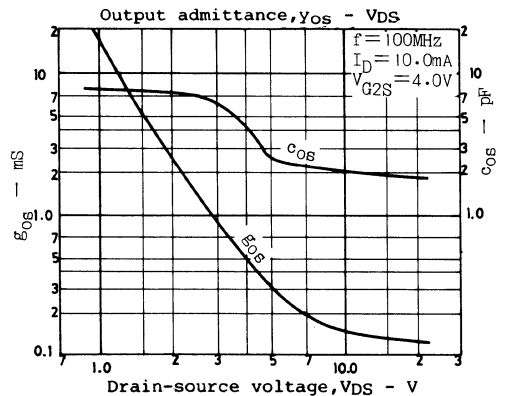
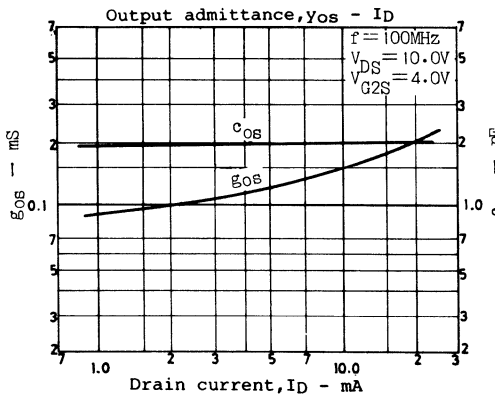
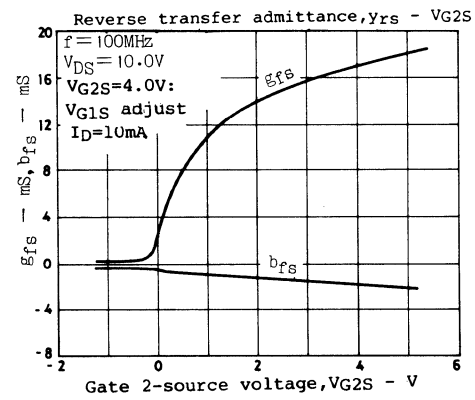
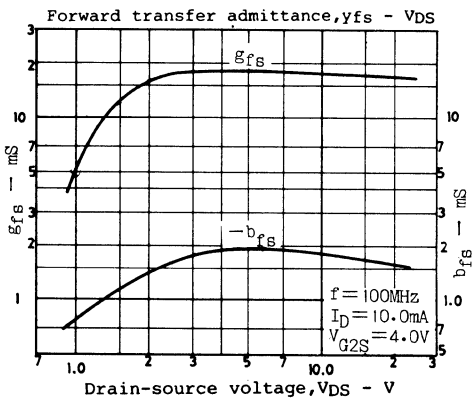
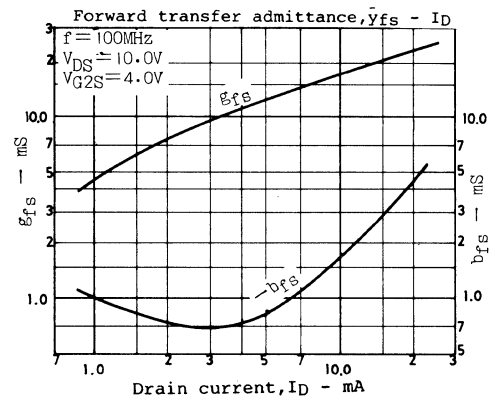
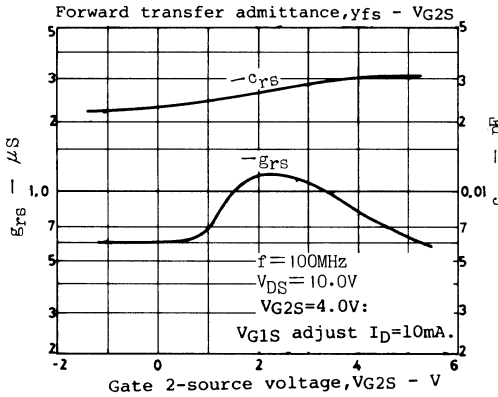
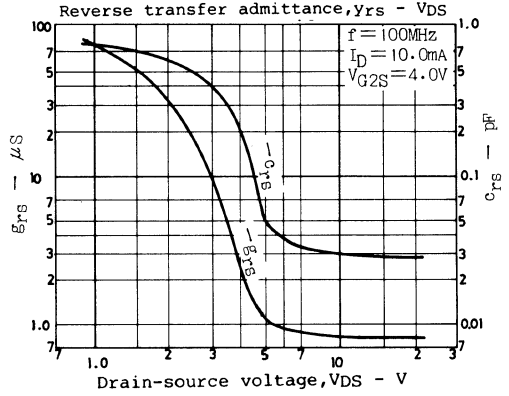
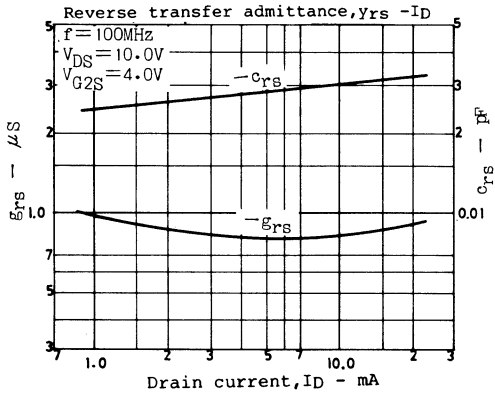
Case Outline 2031A
(unit:mm)

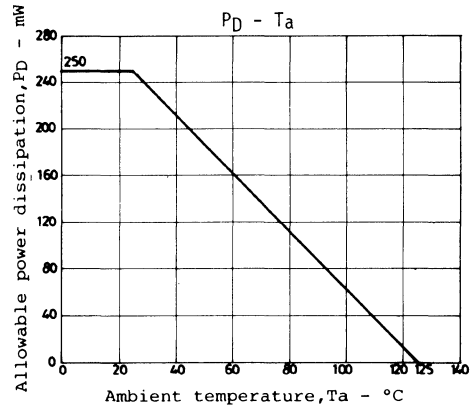
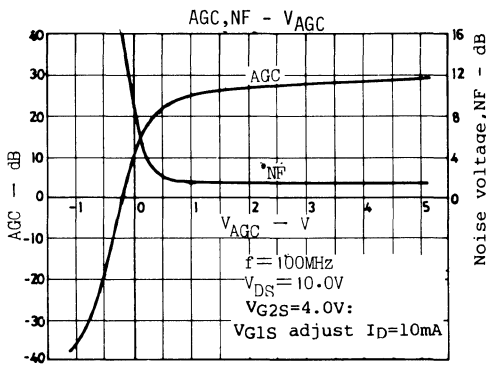
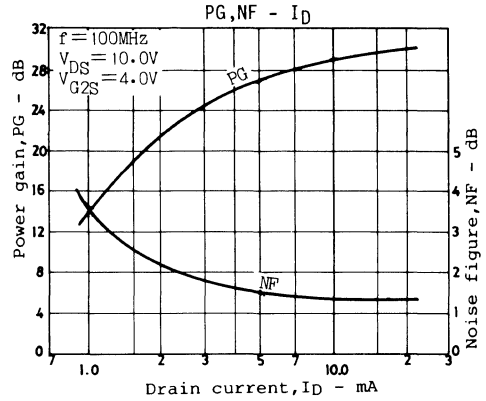
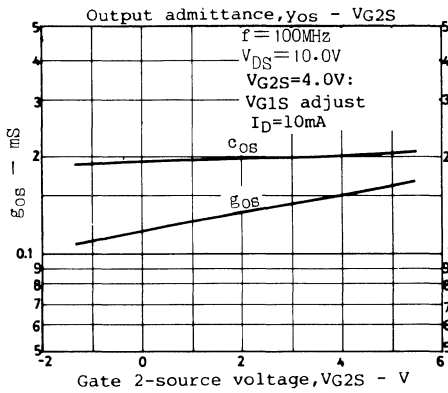


G1: Gate1
S : Source
D : Drain
G2: Gate2
SANYO: DP4A

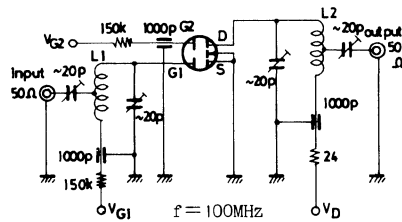








PG, NF, AGC characteristics Test Circuit



L1: 1mm ϕ plated wire 10mm ϕ 4T, tap: 1T from gate side
 L2: 1mm ϕ plated wire 10mm ϕ 6T, tap: 1T from drain side

Sanyo semiconductor products included on the following pages are under development. Their specifications are subject to change without notice.

DEVELOPMENT NEWS

SANYO SEMICONDUCTOR PRODUCTS DEVELOPMENT NEWS

The following semiconductor products are under development. Their specifications are subject to change without notice.

2SA1391/2SC3382

Complementary Pair Silicon Transistors

Low Frequency, Low Noise, General-Purpose Amp Applications

- JEDEC: TO92 package
- Adoption of FBET process
- $V_{CEO} \geq (-)50V$, $I_C = (-)200mA$, $P_C = 400mW$,
 $f_T = 200MHz$ ($V_{CE} = (-)6V$, $I_C = (-)10mA$),
 $h_{FE} = 100 \sim 560$ ($V_{CE} = (-)6V$, $I_C = (-)1mA$).

2SA1392/2SC3383

Complementary Pair Silicon Transistors

Low Frequency, Low Noise, General-Purpose Amp Applications

- JEDEC: TO92 package
- Adoption of FBET process
- $V_{CEO} \geq (-)50V$, $I_C = (-)200mA$, $P_C = 500mW$,
 $f_T = 200MHz$ ($V_{CE} = (-)6V$, $I_C = (-)10mA$),
 $h_{FE} = 100 \sim 560$ ($V_{CE} = (-)6V$, $I_C = (-)1mA$).

2SA1416/2SC3646

Complementary Pair Silicon Transistors

Switching Applications

- SANYO: PCP package
- High breakdown voltage, fast speed
- Adoption of MBIT process
- $V_{CEO} \geq 100V$, $I_C = 1A$, $P_C = 1.3W$.

2SA1417/2SC3647

Complementary Pair Silicon Transistors

Switching Applications

- SANYO: PCP package
- High breakdown voltage, fast speed
- Adoption of MBIT process
- $V_{CEO} \geq 100V$, $I_C = 2A$, $P_C = 1.3W$

2SA1419/2SC3649

Complementary Pair Silicon Transistors

Switching Applications

- SANYO: PCP package
- High breakdown voltage, fast speed
- Adoption of MBIT process
- $V_{CEO} \geq 160V$, $I_C = 1.5A$, $P_C = 1.5W$

2SA1433/2SC3504

Complementary Pair Silicon Transistors -

High-Definition CRT Display Applications

- EIAJ: SC51 package
- High f_T
- Small reverse transfer capacitance
- Adoption of FBET process
- $V_{CEO} \geq (-)60V$, $I_C = (-)50mA$, $P_C = 900mW$,
 $f_T = 700MHz$ ($V_{CE} = (-)10V$, $I_C = (-)10mA$),
 $h_{FE} = 60 \sim 320$ ($V_{CE} = (-)10V$, $I_C = (-)10mA$)

2SA1434/2SC3689

Complementary Pair Silicon Transistors

High h_{FE} , Low Frequency, General-Purpose Amp Applications

- SANYO: CP package
- Very small-sized package permitting 2SA1434/2SC3689-applied sets to be smaller, slimmer
- Adoption of FBET process
- High DC current gain
- Low collector-to-emitter saturation voltage
- High V_{EBO}
- $V_{CEO} \geq (-)50V$, $I_C = (-)100mA$, $P_C = 200mW$
- $f_T = 200MHz$ ($V_{CE} = (-)10V$, $I_C = (-)10mA$),
 $h_{FE} = 800 \sim 3200$ (2SC3689)
500 ~ 1200 (2SA1434)
($V_{CE} = (-)5V$, $I_C = (-)10mA$)

2SA1435/2SC3068

Complementary Pair Silicon Transistors

High h_{FE} , Low Frequency, General-Purpose Amp Applications

- JEDEC: TO92 package
- Adoption of MBIT process
- High DC current gain
- Large current capacity
- Low collector-to-emitter saturation voltage
- High V_{EBO}
- $V_{CEO} \geq (-)25V$, $I_C = (-)300mA$, $P_C = 600mW$
 $f_T = 100MHz$ ($V_{CE} = (-)10V$, $I_C = (-)10mA$)
 $h_{FE} = 500 \sim 1200$ ($V_{CE} = (-)5V$, $I_C = (-)10mA$)

2SA1436/2SC3069

Complementary Pair Silicon Transistors

High h_{FE} , Low Frequency, General-Purpose Amp Applications

- JEDEC: TO92 package
- Adoption of MBIT process
- High DC current gain
- Large current capacity
- Low collector-to-emitter saturation voltage
- High V_{EBO}
- $V_{CEO} \geq (-)50V$, $I_C = (-)200mA$, $P_C = 600mW$
 $f_T = 100MHz$ ($V_{CE} = (-)10V$, $I_C = (-)10mA$)
 $h_{FE} = 500 \sim 1200$ ($V_{CE} = (-)5V$, $I_C = (-)10mA$)

2SA1437/2SC3495

Complementary Pair Silicon Transistors

High h_{FE} , Low Frequency, General-Purpose Amp Applications

- JEDEC: TO92 package
- Very small-sized package permitting 2SA1437/2SC3495-applied sets to be smaller, slimmer
- Adoption of FBET process
- High DC current gain
- High breakdown voltage
- Low collector-to-emitter saturation voltage
- High V_{EBO}
- Small c_{ob}
- $V_{CEO} \geq (-)100V$, $I_C = (-)50mA$, $P_C = 500mW$
 $f_T = 85MHz$ ($V_{CE} = (-)10V$, $I_C = (-)10mA$)
 $h_{FE} = 400 \sim 1000$ ($V_{CE} = (-)5V$, $I_C = (-)10mA$)

2SA1438/2SC3070

Complementary Pair Silicon Transistors

Low Frequency, General-Purpose Amp Applications

- EIAJ: SC51 package
- High h_{FE}
- High V_{EBO}
- $V_{CEO} \geq (-)25V$, $I_C = (-)1.2A$, $P_C = 1W$

2SA1450/2SC3708

Complementary Pair Silicon Transistors

Low Frequency, General-Purpose Amp Applications

- JEDEC: TO92 package
- Adoption of FBET process
- High breakdown voltage
- $V_{CEO} = (-)80V$, $I_C = (-)500mA$, $P_C = 600mW$
 $f_T = 120MHz$ ($V_{CE} = (-)10V$, $I_C = (-)10mA$)
 $h_{FE} = 100 \sim 400$ ($V_{CE} = (-)5V$, $I_C = (-)50mA$)

2SA1469/2SC3746

Complementary Pair Silicon Transistors

Low Saturation Voltage Amp Applications

- SANYO: TO220ML package
- No insulator required for mounting
- Reduced cost and man-hour
- Plastic-covered heat sink facilitating high-density mounting
- $V_{CEO} \geq (-)60V$, $I_C = (-)5A$, $P_C = 30W$ ($T_C = 25^\circ C$)
 $h_{FE} = 70 \sim 280$ ($V_{CE} = (-)2V$, $I_C = (-)1A$)

2SA1470/2SC3747

Complementary Pair Silicon Transistors

Low Saturation Voltage Amp Applications

- SANYO: TO220ML package
- No insulator required for mounting
- Reduced cost and man-hour
- Plastic-covered heat sink facilitating high-density mounting
- $V_{CEO} \geq (-)60V$, $I_C = (-)7A$, $P_C = 40W$ ($T_C = 25^\circ C$)
 $h_{FE} = 70 \sim 280$ ($V_{CE} = (-)2V$, $I_C = (-)1A$)

2SA1471/2SC3748

Complementary Pair Silicon Transistors
Low Saturation Voltage Amp Applications

- SANYO: TO220ML package
- No insulator required for mounting
- Reduced cost and man-hour
- Plastic-covered heat sink facilitating high-density mounting
- $V_{CEO} \geq (-)60V$, $I_C = (-)12A$, $P_C = 30W$ ($T_C = 25^\circ C$)
 $h_{FE} = 70 \sim 280$ ($V_{CE} = (-)2V$, $I_C = (-)1A$)

2SA1474/2SC3780

Complementary Pair Silicon Transistors
Very High-Definition CRT Display Video Output Applications

- JEDEC: TO220 package
- No insulator required for mounting
- Reduced cost and man-hour
- $V_{CEO} \geq (-)60V$, $I_C = (-)0.5A$, $P_C = 15W$ ($T_C = 25^\circ C$)
 $h_{FE} = 40 \sim 320$ ($V_{CE} = (-)10V$, $I_C = (-)50mA$)
 $f_T = 800MHz$ ($V_{CE} = (-)10V$, $I_C = (-)100mA$)

2SA1475/2SC3781

Complementary Pair Silicon Transistors
Very High-Definition CRT Display Video Output Applications

- JEDEC: TO220 package
- No insulator required for mounting
- Reduced cost and man-hour
- Plastic-covered heat sink facilitating high-density mounting
- $V_{CEO} \geq (-)120V$, $I_C = (-)0.3A$, $P_C = 15W$ ($T_C = 25^\circ C$), $h_{FE} = 40 \sim 320$ ($V_{CE} = (-)10V$, $I_C = (-)50mA$), $f_T = 500MHz$ ($V_{CE} = (-)10V$, $I_C = (-)50mA$)

2SA1476/2SC3782

Complementary Pair Silicon Transistors
Very High-Definition CRT Display Video Output Applications

- JEDEC: TO220 package
- High breakdown voltage
- Excellent HF characteristic
- $V_{CEO} \geq (-)200V$, $I_C = (-)0.15A$, $P_C = 15W$ ($T_C = 25^\circ C$)
- $h_{FE} = 40 \sim 320$ ($V_{CE} = (-)10V$, $I_C = (-)10mA$)
 $f_T = 400MHz$ ($V_{CE} = (-)30V$, $I_C = (-)50mA$)

2SA1477/2SC3787

Complementary Pair Silicon Transistors
High Voltage Switching Applications

- SANYO: TO126ML package
- Adoption of FBET process
- High breakdown voltage
- Good linearity of h_{FE} and small c_{ob}
- Fast switching speed
- $V_{CEO} \geq (-)160V$, $I_C = (-)140A$, $P_C = 1.3W$ ($T_C = 25^\circ C$)
 $f_T = 150MHz$ ($V_{CE} = (-)10V$, $I_C = (-)10mA$)
 $h_{FE} = 100 \sim 400$ ($V_{CE} = (-)5V$, $I_C = (-)10mA$)

2SA1478/2SC3788

Complementary Pair Silicon Transistors
High-Definition CRT Display Video Output Applications

- SANYO: TO126ML package
- High breakdown voltage
- Small reverse transfer capacitance and excellent HF characteristic
- Adoption of FBET process
- $V_{CEO} \geq (-)200V$, $I_C = (-)100mA$, $P_C = 1.3W$ ($T_C = 25^\circ C$)
 $f_T = 150MHz$ ($V_{CE} = (-)30V$, $I_C = (-)10mA$)
 $h_{FE} = 40 \sim 320$ ($V_{CE} = (-)10V$, $I_C = (-)10mA$)

2SA1479/2SC3789

Complementary Pair Silicon Transistors
High-Definition CRT Display Video Output Applications

- SANYO: TO126ML package
- High breakdown voltage
- Excellent HF characteristic
- Adoption of MBIT process
- $V_{CEO} = (-)300V$, $I_C = (-)100mA$, $P_C = 1.3W$ ($T_C = 25^\circ C$)
 $f_T = 70MHz$ ($V_{CE} = (-)30V$, $I_C = (-)10mA$)
 $h_{FE} = 40 \sim 320$ ($V_{CE} = (-)10V$, $I_C = (-)10mA$)

2SA1480/2SC3790

Complementary Pair Silicon Transistors
High-Definition CRT Display Video Output
Applications

- SANYO: TO126ML package
- High breakdown voltage
- Small reverse transfer capacitance and excellent HF characteristic
- Adoption of MBIT process
- $V_{CE0} \geq (-)300V$, $I_C = 100mA$, $P_C = 1.3W$ ($T_C = 25^\circ C$)
 $f_T = 150MHz$ ($V_{CE} = (-)30V$, $I_C = (-)10mA$)
 $h_{FE} = 40 \sim 320$ ($V_{CE} = (-)10V$, $I_C = (-)10mA$)

2SA1481/2SC2960

Complementary Pair Silicon Transistors
High Speed Switching Applications

- SANYO: SP package
- Fast switching speed
- $V_{CE0} \geq (-)50V$, $I_C = (-)0.15A$, $P_C = 250W$

2SB1122/2SD1622

Complementary Pair Silicon Transistors
Voltage Regulator, Relay, Lamp, Driver Applications

- SANYO: PCP package
- Low saturation voltage
- $V_{CE0} \geq (-)50V$, $I_C = (-)1A$, $P_C = 1.3W$

2SB1124/2SD1623

Complementary Pair Silicon Transistors
High Current Driver Applications

- SANYO: PCP package
- Low saturation voltage
- Large current capacity
- $V_{CE0} \geq 50V$, $I_C = 3A$, $P_C = 1.5W$

2SB1125/2SD1625

Complementary Pair Silicon Transistors
Driver Applications

- SANYO: PCP package
- High DC current gain
- Large current capacity and wide ASO
- Very small size making it easy to provide high-density, small-sized hybrid IC's
- $V_{CE0} \geq 50V$, $I_C = (-)0.7A$, $P_C = 1.3W$
 $f_T = 200MHz$ ($V_{CE} = (-)5V$, $I_C = (-)50mA$)

2SB1127

Silicon Transistor
High Current Switching Applications

- JEDEC: TO126 package
- Adoption of FBET, MBIT processes
- Low saturation voltage
- Large current capacity
- Fast switching speed
- $V_{CE0} \geq -20V$, $I_C = -5A$, $P_C = 1W$
 $f_T = 320MHz$ ($V_{CE} = -5V$, $I_C = -200mA$)
 $h_{FE} = 100 \sim 400$ ($V_{CE} = -2V$, $I_C = -500mA$)

2SB1131

Silicon Transistor
High Current Switching Applications

- EIAJ: SC51 package
- Adoption of FBET, MBIT processes
- Low saturation voltage
- Large current capacity
- Fast switching speed
- $V_{CE0} = -20V$, $I_C = -5A$, $P_C = 1W$
 $f_T = 320MHz$ ($V_{CE} = -5V$, $I_C = -200mA$)
 $h_{FE} = 100 \sim 400$ ($V_{CE} = -2V$, $I_C = -500mA$)

2SB1133/2SD1666

Complementary Pair Silicon Transistors
Low Frequency, General-Purpose Amp
Applications

- SANYO: TO220ML package
- No insulator required for mounting
- Reduced cost and man-hour
- Plastic-covered heat sink facilitating high-density mounting
- $V_{CE0} \geq (-)60V$, $I_C = (-)3A$, $P_C = 20W$ ($T_C = 25^\circ C$)
 $h_{FE} = 60 \sim 320$ ($V_{CE} = (-)2V$, $I_C = (-)1A$)

2SB1134/2SD1667

Complementary Pair Silicon Transistors
Low Frequency, General-Purpose Amp
Applications

- SANYO: TO220ML package
- No insulator required for mounting
- Reduced cost and man-hour
- Plastic-covered heat sink facilitating high-density mounting
- $V_{CE0} \geq (-)50V$, $I_C = 5A$, $P_C = 20W$ ($T_C = 25^\circ C$)
 $h_{FE} = 70 \sim 280$ ($V_{CE} = (-)2V$, $I_C = (-)1A$)

2SB1135/2SD1668

Complementary Pair Silicon Transistors
Low Saturation Voltage Amp Applications

- SANYO: TO220ML package
- No insulator required for mounting
- Reduced cost and man-hour
- Plastic-covered heat sink facilitating high-density mounting
- $V_{CE0} \geq (-)50V$, $I_C = (-)7A$, $P_C = 25W$ ($T_C = 25^\circ C$)
 $h_{FE} = 70 \sim 280$ ($V_{CE} = (-)2V$, $I_C = (-)1A$)

2SB1136/2SD1669

Complementary Pair Silicon Transistors
Low Saturation Voltage Amp Applications

- SANYO: TO220ML package
- No insulator required for mounting
- Reduced cost and man-hour
- Plastic-covered heat sink facilitating high-density mounting
- $V_{CE0} \geq (-)50V$, $I_C = (-)7A$, $P_C = 30W$ ($T_C = 25^\circ C$)
 $h_{FE} = 70 \sim 280$ ($V_{CE} = (-)2V$, $I_C = (-)1A$)

2SB1140/2SD1685

Complementary Pair Silicon Transistors
High Current Switching Applications

- SANYO: TO126ML package
- Micaless type
- Large current capacity
- $V_{CE0} \geq (-)20V$, $I_C = (-)5A$, $P_C = 1.3W$

2SB1141/2SD1681

Complementary Pair Silicon Transistors
Medium Speed Switching Applications

- SANYO: TO126ML package
- Micaless type
- High collector dissipation
- $V_{CE0} \geq 18V$, $I_C = 1.2A$, $P_C = 1.3W$

2SB1142/2SD1682

Complementary Pair Silicon Transistors
Medium Speed Switching Applications

- SANYO: TO126ML package
- Micaless type
- High collector dissipation
- Low saturation voltage
- $V_{CE0} \geq (-)50V$, $I_C = (-)2.5A$, $P_C = 1.3W$

2SB1143/2SD1683

Complementary Pair Silicon Transistors
High Current Switching Applications

- SANYO: TO126ML package
- Micaless type
- Low saturation voltage
- Large current capacity
- $V_{CE0} \geq (-)50V$, $I_C = (-)4A$, $P_C = 1.3W$

2SB1144/2SD1684

Complementary Pair Silicon Transistors
Medium Speed Switching Applications

- JEDEC: TO126 package
- Micaless type
- High breakdown voltage
- $V_{CE0} \geq (-)100V$, $I_C = (-)1A$, $P_C = 1.3W$

2SC3661

Silicon Transistor
High h_{FE} , Low Frequency, General-Purpose Amp Applications

- SANYO: CP package
- Very small-sized package permitting 2SC3661-applied sets to be smaller, slimmer
- Adoption of FBET process
- High DC current gain
- Low collector-to-emitter saturation voltage
- High V_{EBO}
- $V_{CE0} \geq 25V$, $I_C = 300mA$, $P_C = 200mW$
 $f_T = 250MHz$ ($V_{CE} = 10V$, $I_C = 10mA$)
 $h_{FE} = 800 \sim 3200$ ($V_{CE} = 5V$, $I_C = 10mA$)

2SC3685

Silicon Transistor
Very High-Definition CRT Display Horizontal Deflection Output Applications

- SANYO: TO3PB package
- Fast switching speed
- Wide ASO
- $V_{CBO} \geq 1500V$, $I_C = 6A$, $P_C = 120W$ ($T_C = 25^\circ C$)
 $t_f \leq 0.2\mu s$.

2SC3686

Silicon Transistor

Very High-Definition CRT Display Horizontal Deflection Output Applications

- SANYO: TO3PB package
- Fast switching speed
- Wide ASO
- $V_{CBO} \geq 1500V$, $I_C = 7A$, $P_C = 120W$ ($T_C = 25^\circ C$)
 $t_f \leq 0.2\mu s$

2SC3687

Silicon Transistor

Very High-Definition CRT Display Horizontal Deflection Output Applications

- SANYO: TO3PB package
- Fast switching speed
- Wide ASO
- $V_{CBO} \geq 1500V$, $I_C = 8A$, $P_C = 150W$ ($T_C = 25^\circ C$)
 $t_f \leq 0.2\mu s$

2SC3688

Silicon Transistor

Very High-Definition CRT Display Horizontal Deflection Output Applications

- SANYO: TO3PB package
- Fast switching speed
- Wide ASO
- $V_{CBO} \geq 1500V$, $I_C = 10A$, $P_C = 150W$ ($T_C = 25^\circ C$)
 $t_f \leq 0.2\mu s$

2SC3705

Silicon Transistor

Printer Driver Applications

- JEDEC: TO126 package
 - High DC current gain
 - On-chip avalanche diode of $60 \pm 10V$ connected across collector and base
- High inductive load handling capability
 $V_{CEO} \geq 50V$, $I_C = 1.2A$, $P_C = 10W$ ($T_C = 25^\circ C$)
 $f_T = 180MHz$ ($V_{CE} = 5V$, $I_C = 1A$)
 $h_{FE} = 4000$ ($V_{CE} = 5V$, $I_C = 1A$)

2SC3708

Silicon Transistor

Low Frequency, General-Purpose Amp Applications

- JEDEC: TO92 package
- Adoption of FBET process
- High breakdown voltage
- $V_{CEO} \geq 80V$, $I_C = 500mA$, $P_C = 600mW$
 $f_T = 120MHz$ ($V_{CE} = 10V$, $I_C = 10mA$)
 $h_{FE} = 100 \sim 560$ ($V_{CE} = 5V$, $I_C = 50mA$)

2SC3749

Silicon Transistor

High Voltage, High Speed Switching Applications

- SANYO: TO220ML package
- No insulator required for mounting
- Reduced cost and man-hour
- Plastic-covered heat sink facilitating high-density mounting
- $V_{CEO} \geq 500V$, $I_C = 3A$, $P_C = 25W$ ($T_C = 25^\circ C$)
 $h_{FE} \geq 8$ ($V_{CE} = 5V$, $I_C = 1.5A$)
 $t_f \leq 0.3\mu s$

2SC3750

Silicon Transistor

High Voltage, High Speed Switching Applications

- SANYO: TO220ML package
- No insulator required for mounting
- Reduced cost and man-hour
- Plastic-covered heat sink facilitating high-density mounting
- $V_{CEO} \geq 500V$, $I_C = 5A$, $P_C = 30W$ ($T_C = 25^\circ C$)
 $h_{FE} \geq 8$ ($V_{CE} = 5V$, $I_C = 3A$)
 $t_f \leq 0.3\mu s$

2SC3751

Silicon Transistor

High Voltage, High Speed Switching Applications

- SANYO: TO220ML package
- No insulator required for mounting
- Reduced cost and man-hour
- Plastic-covered heat sink facilitating high-density mounting
- $V_{CEO} \geq 800V$, $I_C = 1.5A$, $P_C = 25W$ ($T_C = 25^\circ C$)
 $h_{FE} \geq 8$ ($V_{CE} = 5V$, $I_C = 0.1A$)
 $t_f \leq 0.3\mu s$

2SC3752

Silicon Transistor

High Voltage, High Speed Switching Applications

- SANYO: TO220ML package
- No insulator required for mounting
- Reduced cost and man-hour
- Plastic-covered heat sink facilitating high-density mounting
- $V_{CEO} \geq 800V$, $I_C = 3A$, $P_C = 30W$ ($T_C = 25^\circ C$)
 $h_{FE} \geq 8$ ($V_{CE} = 5V$, $I_C = 0.2A$)
 $t_f \leq 0.3\mu s$

2SC3753

Silicon Transistor

High-Definition CRT Display Horizontal Deflection Output Applications

- SANYO: TO3PML package
- No insulator required for mounting
- Reduced cost and man-hour
- Plastic-covered heat sink facilitating high-density mounting
- $V_{CBO} \geq 1500V$, $I_C = 5A$, $P_C = 60W$
 $t_f \leq 0.3\mu s$

2SC3754

Silicon Transistor

High-Definition CRT Display Horizontal Deflection Output Applications

- SANYO: TO3PML package
- No insulator required for mounting
- Reduced cost and man-hour
- Plastic-covered heat sink facilitating high-density mounting
- On-chip damper diode
- $V_{CBO} \geq 1500V$, $I_C = 6A$, $P_C = 60W$
 $t_f \leq 0.3\mu s$

2SC3755

Silicon Transistor

High-Definition CRT Display Horizontal Deflection Output Applications

- SANYO: TO3PML package
- No insulator required for mounting
- Reduced cost and man-hour
- Plastic-covered heat sink facilitating high-density mounting
- $V_{CBO} \geq 1500V$, $I_C = 5A$, $P_C = 60W$
 $t_f \leq 0.3\mu s$

2SC3756

Silicon Transistor

High-Definition CRT Display Horizontal Deflection Output Applications

- SANYO: TO3PML package
- No insulator required for mounting
- Reduced cost and man-hour
- Plastic-covered heat sink facilitating high-density mounting
- $V_{CBO} \geq 1500V$, $I_C = 6A$, $P_C = 60W$,
 $t_f \leq 0.3\mu s$

2SC3771

Silicon Transistor

High Frequency Amp Applications

- SANYO: CP package
- High power gain
- Small noise figure
- High cutoff frequency
- $V_{CEO} \geq 20V$, $I_C = 30mA$, $P_C = 250mW$,
 $f_T = 2.2GHz$ ($V_{CE} = 10V$, $I_C = 5mA$)
 $h_{FE} = 40 \sim 200$ ($V_{CE} = 10V$, $I_C = 5mA$)

2SC3772

Silicon Transistor

Low Noise Amp, Wide Band Amp Applications

- SANYO: CP package
- Small noise figure
- High power gain
- High cutoff frequency
- $V_{CEO} \geq 16V$, $I_C = 70mA$, $P_C = 250mW$,
 $f_T = 3.0GHz$ ($V_{CE} = 10V$, $I_C = 10mA$)
 $h_{FE} = 40 \sim 200$ ($V_{CE} = 10V$, $I_C = 10mA$)

2SC3773

Silicon Transistor

Low Noise Amp, Wide Band Amp Applications

- SANYO: CP package
- Small noise figure
- High power gain
- High cutoff frequency
- $V_{CEO} \geq 16V$, $I_C = 50mA$, $P_C = 250mW$,
 $f_T = 3.5GHz$ ($V_{CE} = 10V$, $I_C = 5mA$)
 $h_{FE} = 40 \sim 200$ ($V_{CE} = 10V$, $I_C = 5mA$)

2SC3777

Silicon Transistor

Low Noise Amp, Wide Band Amp Applications

- JEDEC: TO92 package
- Small noise figure
- High power gain
- High cutoff frequency
- $V_{CEO} \geq 16V$, $I_C = 50mA$, $P_C = 400mW$,
 $f_T = 3.5GHz$ ($V_{CE} = 10V$, $I_C = 5mA$)
 $h_{FE} = 40 \sim 200$ ($V_{CE} = 10V$, $I_C = 5mA$)

2SC3774

Silicon Transistor

Low Noise Amp, Wide Band Amp Applications

- SANYO: CP package
- Small noise figure
- High power gain
- High cutoff frequency
- $V_{CEO} \geq 12V$, $I_C = 70mA$, $P_C = 250mW$,
 $f_T = 5.0GHz$ ($V_{CE} = 10V$, $I_C = 20mA$)
 $h_{FE} = 40 \sim 200$ ($V_{CE} = 10V$, $I_C = 20mA$)

2SC3778

Silicon Transistor

Low Noise Amp Applications

- JEDEC: TO92 package
- Small noise figure
- High power gain
- High cutoff frequency
- $V_{CEO} \geq 12V$, $I_C = 70mA$, $P_C = 500mW$,
 $f_T = 5.0GHz$ ($V_{CE} = 10V$, $I_C = 20mA$)
 $h_{FE} = 40 \sim 200$ ($V_{CE} = 10V$, $I_C = 20mA$)

2SC3775

Silicon Transistor

Low Noise Amp, Wide Band Amp Applications

- SANYO: CP package
- Small noise figure
- High power gain
- High cutoff frequency
- $V_{CED} \geq 12V$, $I_C = 100mA$, $P_C = 250mW$,
 $f_T = 5.0GHz$ ($V_{CE} = 10V$, $I_C = 20mA$)
 $h_{FE} = 40 \sim 200$ ($V_{CE} = 10V$, $I_C = 20mA$)

2SC3779

Silicon Transistor

Low Noise Amp, Wide Band Amp Applications

- JEDEC: TO92 package
- Small noise figure
- High power gain
- High cutoff frequency
- $V_{CEO} \geq 12V$, $I_C = 100mA$, $P_C = 600mW$,
 $f_T = 5.0GHz$ ($V_{CE} = 10V$, $I_C = 20mA$)
 $h_{FE} = 40 \sim 200$ ($V_{CE} = 10V$, $I_C = 20mA$)

2SC3776

Silicon Transistor

Low Noise Amp, Wide Band Amp Applications

- SANYO: TO92 package
- Small noise figure
- High power gain
- High cutoff frequency
- $V_{CEO} \geq 16V$, $I_C = 70mA$, $P_C = 400mW$,
 $f_T = 3.0GHz$ ($V_{CE} = 10V$, $I_C = 10mA$)
 $h_{FE} = 40 \sim 200$ ($V_{CE} = 10V$, $I_C = 10mA$)

2SC3784

Silicon Transistor

Driver Applications

- JEDEC: TO126 package
- High DC current gain
- Large current capacity and wide ASO
- On-chip avalanche diode of $60 \pm 10\text{V}$ connected across collector and base
- Uniformity in collector-to-base breakdown voltage due to adoption of precision impurity diffusion process
- High inductive load handling capability
- $V_{CE0} \geq 50\text{V}$, $I_C = 1.2\text{A}$, $P_C = 10\text{W}$ ($T_C = 25^\circ\text{C}$),
 $f_T = 180\text{MHz}$ ($V_{CE} = 5\text{V}$, $I_C = 0.5\text{A}$),
 $h_{FE} = 4000$ ($V_{CE} = 5\text{V}$, $I_C = 0.5\text{A}$)

2SC3785

Silicon Transistor

Driver Applications

- JEDEC: TO126 package
- High DC current gain
- Large current capacity and wide ASO
- On-chip avalanche diode of $60 \pm 10\text{V}$ connected across collector and base
- Uniformity in collector-to-base breakdown voltage due to adoption of precision impurity diffusion process
- High inductive load handling capability
- $V_{CE0} \geq 50\text{V}$, $I_C = 2\text{A}$, $P_C = 10\text{W}$ ($T_C = 25^\circ\text{C}$),
 $f_T = 180\text{MHz}$ ($V_{CE} = 5\text{V}$, $I_C = 1\text{A}$),
 $h_{FE} = 4000$ ($V_{CE} = 5\text{V}$, $I_C = 1\text{A}$)

2SC3786

Silicon Transistor

High Speed Driver Applications

- JEDEC: TO126 package
- High DC current gain
- Large current capacity and wide ASO
- On-chip avalanche diode of $60 \pm 10\text{V}$ connected across collector and base
- Uniformity in collector-to-base breakdown voltage due to adoption of precision impurity diffusion process
- High inductive load handling capability
- $V_{CE0} \geq 50\text{V}$, $I_C = 3\text{A}$, $P_C = 10\text{W}$ ($T_C = 25^\circ\text{C}$),
 $f_T = 180\text{MHz}$ ($V_{CE} = 5\text{V}$, $I_C = 1.5\text{A}$),
 $h_{FE} = 4000$ ($V_{CE} = 5\text{V}$, $I_C = 1.5\text{A}$)

2SC3792

Silicon Transistor

Low Frequency Amp Applications

- JEDEC: TO92 package
- Highly resistant to surge voltage because of high V_{EBO}
- Wide ASO
- $V_{CE0} \geq 20\text{V}$, $I_C = 300\text{mA}$, $P_C = 500\text{mW}$

2SD1620

Silicon Transistor

1.5V, 3V Strobe Applications

- SANYO: PCP package
- Less power dissipation because of low $V_{CE}(\text{sat})$, permitting more flashes of light to be emitted
- Large current capacity and highly resistant to breakdown
- Excellent linearity of h_{FE} from low current to high current
- Very small size making it easy, to provide high-density, small-sized hybrid IC's
- $V_{CE0} \geq 10\text{V}$, $I_C = 3\text{A}$, $P_C = 500\text{mW}$,
 $f_T = 200\text{MHz}$ ($V_{CE} = 10\text{V}$, $I_C = 50\text{mA}$),
 $h_{FE} = 210$ ($V_{CE} = 2\text{V}$, $I_C = 3\text{A}$)

2SD1627

Silicon Transistor

Driver Applications

- SANYO: PCP package
- High DC current gain
- High current
- $V_{CE0} \geq 25\text{V}$, $I_C = 2\text{A}$, $P_C = 1.5\text{W}$

2SD1648

Silicon Transistor

Switching Applications

- SANYO: CP package
- On-chip bias resistance
- $V_{CE0} \geq 15\text{V}$, $I_C = 30\text{mA}$, $P_C = 200\text{mW}$,

2SK536

Silicon Enhancement MOS FET
Analog Switch Applications

- SANYO: CP package
- High $|y_{fs}|$
- Enhancement type
- Small ON-resistance
- $V_{GS} = \pm 12V$, $I_D = 100mA$, $P_D = 200mW$

2SK595

Silicon N Channel FET
Capacitor Microphone Applicatons

- SANYO: CP package
- Good transient characteristic
- $V_{GDO} \geq 20V$, $I_D = 10mA$, $P_D = 100mW$

2SK596

Silicon N Channel FET
Capacitor Microphone

- SANYO: SP package
- Good transient characteristic
- $V_{GDO} \geq 20V$, $I_D = 10mA$, $P_D = 100mW$

2SK597

Silicon N Channel FET
Capacitor Microphone Applications

- SANYO: DP package
- Good transient characteristic
- $V_{GDO} \geq 20V$, $I_D = 10mA$, $P_D = 100mW$

3SK167

GaAs Dual Gate MES FET
VHF Amp, Mixer Applications

- SANYO: CP4 package
- Low I_{DSS} and high g_m
- Very low noise ($f = 800MHz$, 1.2dB)
- High voltage gain
- $V_{DS} = 12V$, $I_D = 90mA$, $P_D = 200mW$

3SK168

GaAs Dual Gate MES FET
UHF Amp, Mixer Applications

- SANYO: DP4 package
- Low I_{DSS} and high g_m
- Very low noise
- High voltage gain
- $V_{DS} = 12V$, $I_D = 90mA$, $P_D = 200mW$



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